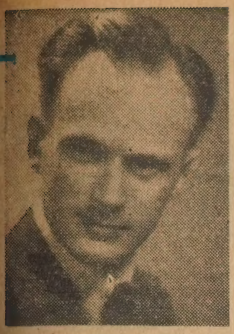

Editorial

DAME ENID LYONS, whose appointment to the Australian Broadcasting Commission was announced recently, celebrated the occasion by condemning the practice of devoting almost the whole of Saturday afternoons to sporting broadcasts.

With this opinion I heartily agree, not only as it affects the ABC but all other stations as well.

It may be that the large majority of Australians are interested in sport. But it isn't so important that, because of a virtual monopoly of the ether on Saturday afternoons, no one can tune in to a decent musical program.

Even if sport is the major attraction on Saturdays, does that justify five or six simultaneous broadcasts of the same race? I cannot think so. And neither can thousands of others.

We will not achieve a balanced broadcast system until some co-operation is established between broadcasting interests as a whole. One of the difficulties is the desire of each commercial station to hold as many listeners as possible at any one time to provide an audience for the appeals of the advertiser sponsoring the broadcast. It is a legitimate result of commercial activity, but it can be taken too far.

I'm not making the point that commercial stations are a bad thing. Every system has weaknesses, and we must do our best to overcome these. If Dame Enid can do anything to bring her ideas into practice, she will have plenty of grateful listeners.

And while she is about it, she might see whether the Parliamentary broadcasts can be rationalised.

The ABC is in a spot about these, for it has a legal obligation to keep them on the air.

Recently thousands of listeners were disappointed to miss a particularly fine concert from the Sydney Town Hall in which Thalben-Ball gave a magnificent performance. The Senate decided to sit until 10 pm that evening, and its proceedings had to be broadcast. Ironically the broadcast was one of the least edifying I have ever heard. It consisted of arguments on procedure, about five divisions, and exactly nil business being transacted.

At 10 pm the ABC broadcast a recording of the concert, and a good one, too, but most listeners who wanted the concert had gone sorrowfully to bed.

If Dame Enid can help extricate the ABC from some of these difficulties, she will be doing a good job.

John Moyle

INDEX

	Page
ertoons Are Hard Work	3
reat Voices On M-G	7
e Sounds You Cannot Hear	9
teors—Bombs From Beyond	12
chnical Review	15
ws And Reviews	21
's Buy An Argument	24
gnetic Recording—Drive Systems	31
arn While You Build	36
Course In Television	41
Tuning Circuits For Receivers	45
The 1951 Majestic Radiogram	48
Here's Your Answer Tom	58
A 576 Mc Trans-Receiver	60
The Servicemen Who Tells	65
A Reader Built It	70
How To Find The Right Exposure	73
Short Wave Notes	84
The Ham Bands	85
Record News and Views	90
Answers To Correspondents	93

RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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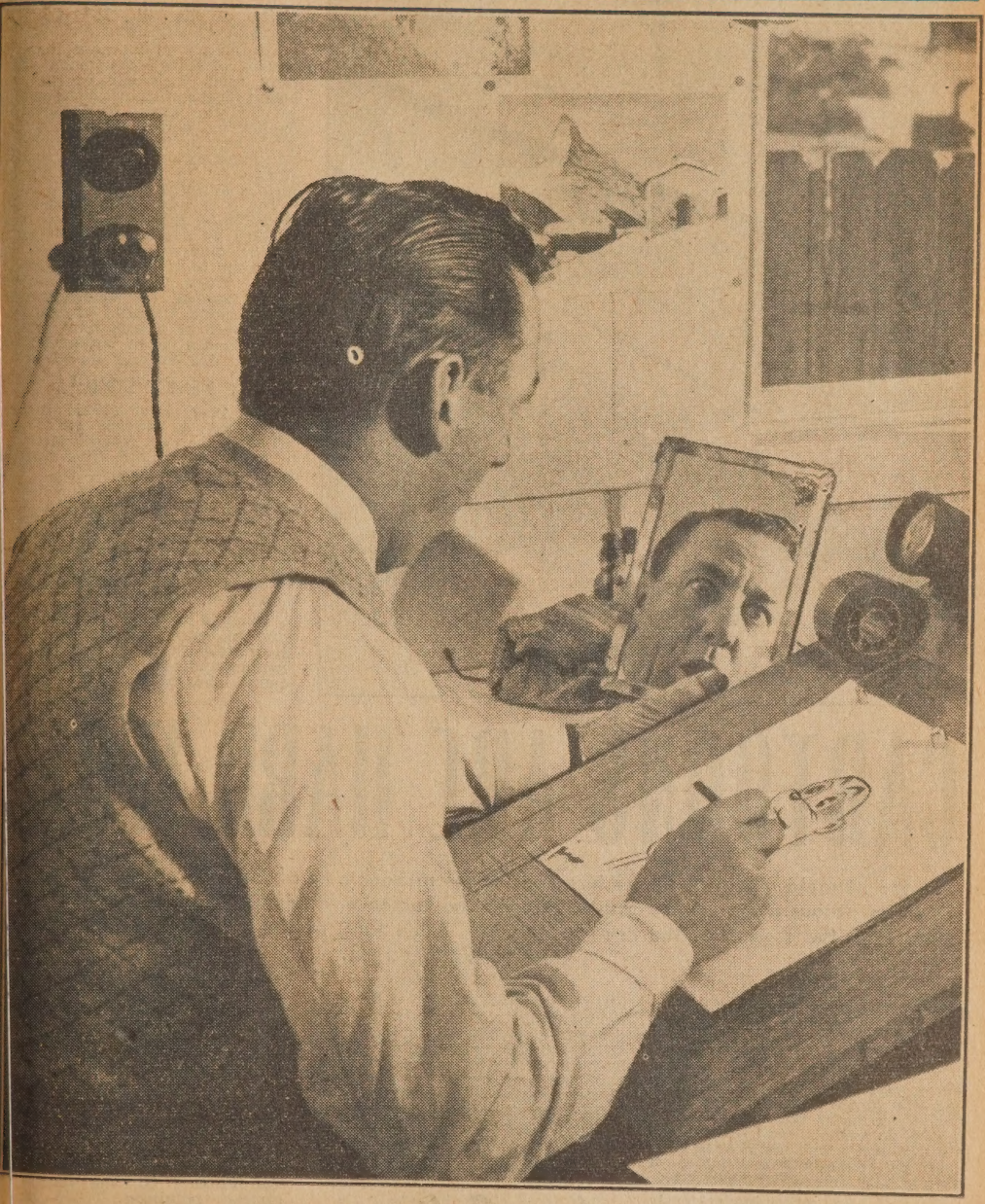
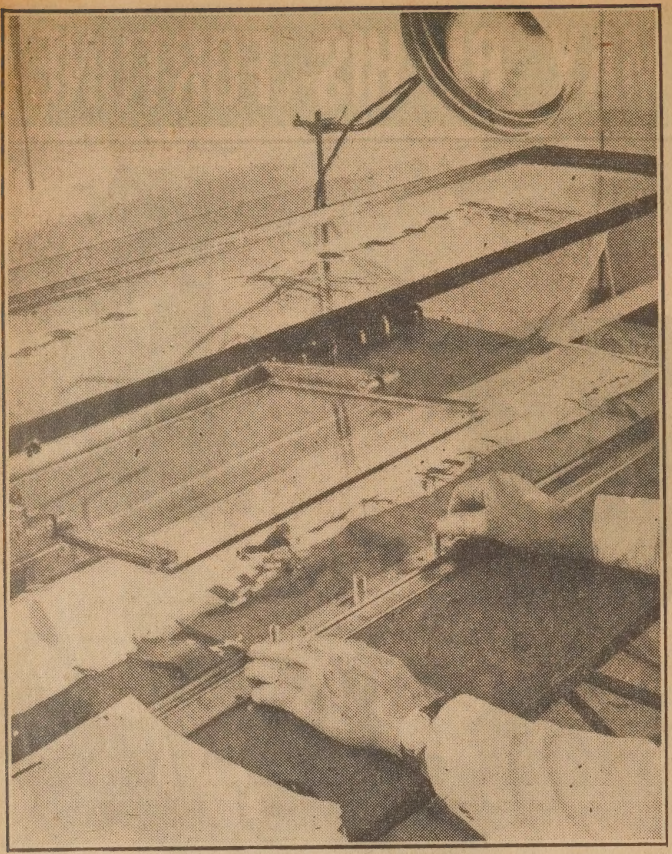
OUR COVER PICTURE

One of the highest frequency bands available to amateur transmitters is around 576 mc. This experimental trans-receiver is described on page 60 of this issue.

HIS FACE MAY BE HIS FORTUNE



UT In any case it helps cartoonist Eric Porter to find the right expression for his character "Willie Wombat." Porter is one of the few Australian cartoonists preparing original material for the films. He makes them ainly for advertising and for some Government departments. Some of the secrets which have helped Disney and others to fame and fortune are told in the following pages.



Turn this picture upside down and you will see clearly how the camera shoots scenes in two planes. Glass plate and registration pins hold "cell" in exact position for technicolor shot.

ploit it to the full. It is the m secret of the success of their craf

But animation is more than making of Silly Symphonies. S fully used, it is one of the n potent means of communicating id yet devised. Hence its powerful fluence in training soldiers for or workers for industry, or, above its success as an advertising medi Animation, in short, is a big serious business.

The first successful cartoons s as we know them today, were m in 1906 by one Stuart Blackton, English black-and-white artist, had gone to try his fortune in N York. There, working for the V graph Studios, he created a se of animated cartoons of odd i dents such as a man blowing c smoke and a clown putting his forming dog through its tricks.

"LITTLE NEMO" STRIP

Five years later (1911) Black persuaded a famous comic s artist of the day, Winsor McCay make a six-minute film featu his popular newspaper strip c acter Little Nemo. The Vitagr people launched this cartoon u the title Winsor McCay Makes Cartoons Move and were justifi gratified with the sensation it cau In those days it was really somet to see a newspaper artist's creat moving on the screen.

To avoid jerkiness and get the sion of smooth movement, M drew 4000 separate sketches, complete with background. This mense labor on the part of one a

CARTOONS ARE HARD WOR

In the intimate gloom of the picture theatre the monochrome of the newsreel gives way to title in riotous color. A stir ripples through the audience, a mixture of anticipation and r lief from the tension of the news of the day — the King of the Silly Symphonies, Dona Duck, hits the screen.

HOW can one explain the truly universal appeal of the animated cartoon? Mr. Everyman might answer, "It's just that we are all kids at heart" — and this is true enough. But a psychologist would go on to add that it not only helps us temporarily to forget our worries — as, indeed, do practically all films — but also provides a welcome change from even the make-believe troubles of the ordinary screenplay characters.

For they often either inadvertently remind us of our real life worries or, because of their skilful acting, enable us too realistically to identify ourselves with them and the harrowing experiences they suffer before they reach their happy ending.

But the cartoon does more than this. As its zany situations develop with lightning speed, taking one utterly unexpected turn after another, as its characters suffer and perpetrate incredible violence, we in the audience experience a release-by-proxy of all the suppressed-since-childhood desires for mayhem and destruction that are part of the make-up of every normal man and woman.

The makers of the animated cartoon know this and naturally ex-

by Colin Cosgrove

seems incredible, but McCay apparently a glutton for work, following the success of his effort he almost completely doned newspaper work in fav his new medium.

No doubt the fact that he make much more money by doi had a lot to do with it. In event, McCay went from str to strength and in 1918 proc his masterpiece. This was The Sinking Of The Lusitan cartoon requiring 25,000 sep drawings, a job that took hi months!

Other men were quick to f the successful lead of Blackto McCay, and, in the followin years the animated cartoon dev ed into the technically perfect duct we know today.

Undoubtedly, if any one man

e credited with this present day per-
ection, that man is Walt Disney.

Disney's is a story in the true rags-
-riches Hollywood tradition. He
egan life as a farm boy in Mis-
ouri, where, no doubt, he knew and
oved the many animals which were
ter to people and popularise his
artoons around the world. When
alt was 10 his family moved to
ansas City. Here Walt delivered
apers before school each day to
igment the family budget.

Not unnaturally, his school books
ere full of sketches and he develop-
a trick of drawing people in
adjusted poses on succeeding pages.
apidly flipping the pages gave a
ude but effective illusion of move-
ent, a device familiar to every
hool child today. In his 17th year
sney managed to secure some art
aining at the Chicago Art Insti-
te.

ISNEY'S START

The resulting improvement in his
rk won him first a job as a slide
ustrator for cinema advertisements
d then an opportunity to try his
k in Hollywood. There, follow-
some initial failures due to tech-
al difficulties, a big studio spon-
ed and released his first success-
cartoon, Oswald The Rabbit.

His long string of brilliant pro-
ctions since is familiar to all. One
ed only recall Steamboat Willie,
ckey Mouse, Donald Duck and the
t and then Snow White And The
ven Dwarfs and such master-
ces as Fantasia and Make Mine
sic to realise the formidable
hievement of this man Walt Dis-
y.

The many developments in tech-
ue initiated by him contributed
siderably to the success of the
lied War effort, first with training
ms and then to the Allies' coun-
-propaganda campaign in
ightening out many of the Nazi-
nufactured kinks in the minds of
erated peoples.

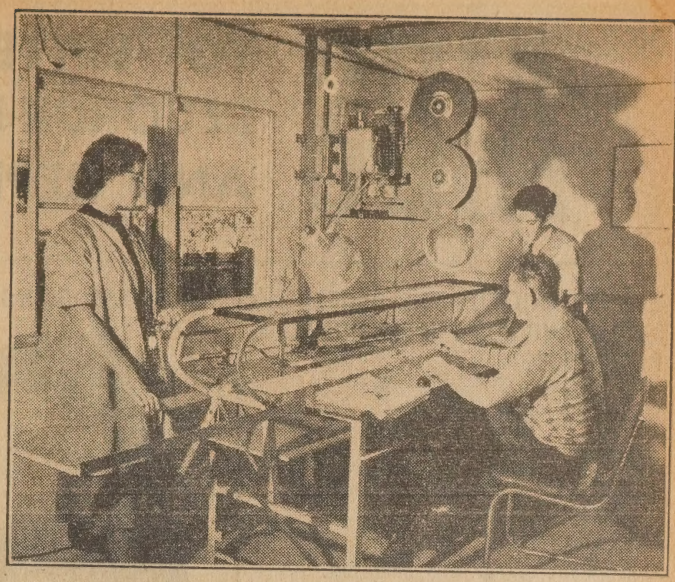
Today, it is a far cry from the
lorious one-man cartoon making
Winsor McCay's time. The big
et of turning out first-class anim-
d cartoons in quantity is that of
a successful film work, namely
mwork. Teamwork plus the many
rt cuts and technical improve-
nts discovered since the days of
"Little Nemo" and "Felix the Kat."

CARTOON TEAM

The typical team comprises: 1,
ector; 2, Musical director; 3,
o or three senior artists to create
e leading situations; 4, The layout
n; 5, Scenario writer, and 6, A
ip of artists who usually split
work three ways; a, Animation;
nking (the transfer of the anim-
s' drawings to transparent sheets)
C, Backgrounds.

When a story idea has been decided
by the studio heads, the gag artists,
ose job is to work out all the funny
situations in the story, are called in
ther with the director, the musical
ctor and the team of artists for
ound-table conference. The up-
of this meeting is the creation
the artists of the whole story in
form of a series of leading comic
situations, sketched on paper. The
enario writer also prepares a defin-
tory outline at this point.

The director and the music leader
get together, discuss the cartoon's

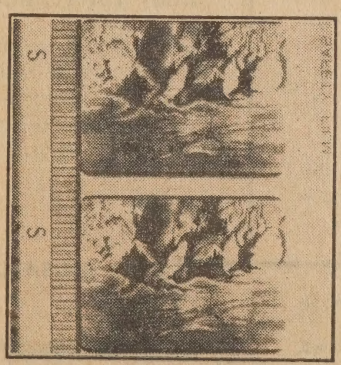


Here is the complete "shooting" table of which the previous picture showed a part. Cameraman (seated) operates multi-plane camera with help of two assistants.

sequences and decide on the type of music which is to accompany the various actions. A certain amount of give and take is necessary here as, usually, the story told in the image cannot readily be fitted to the music chosen, in which case a special musical score is composed to suit.

An epoch-making aspect of "Fantasia" was the complete subordination of the image to the music, the latter being played in a perfectly straight manner just as though for a Carnegie Hall concert, while the entire image was created both to suit the music and yet also most artistically tell the story.

When the director and the music leader have decided on the type of



Typical section of film showing sound track at the left.

music, this must then be fitted to the story. One episode of a certain mood may last only ten seconds, another fifty. The music must be carefully planned to fit—to the split second.

This is done with the aid of a diagram much like a musican's score on which every frame of the image is fitted to the appropriate note of the music, the exact relation depending on the musical tempo. Director and musican continue in this fashion through the whole film, until the entire story is welded to the music.

With the aid of this image score, the layout man then works out the number of movements required in each bit of action. He makes a separate drawing for each of these scenes and then compiles a list of the complete sets needed to "animate" them. These lists and scene sketches go to the artists and, since the average cartoon needs up to 20,000 separate drawings, far too much work for even three or four men when time is important, the work is divided up among a large number of senior and junior animators.

ANIMATORS AT WORK

The animators have the important job of making the master drawings of each movement. In a scene where Donald Duck is walking along a road, for example, it may take 16 drawings to show him making one step forward. The key drawings here would be numbers 1, 8 and 16, made by the animator. Drawings 2 to 7 and 9 to 15 can then safely be entrusted to student animators or, as they are sometimes called, the "in-between-ers."

Occasionally, due to the peculiar nature of the movement involved, it is extremely difficult to achieve complete naturalness. In such a case a human actor is photographed making the movement and a positive film strip or a complete set of paper prints made available to the animators for study and translation into cartoon characters.

Other artists, called "inkers," have the job of transferring the animators' drawings to celluloid sheets.

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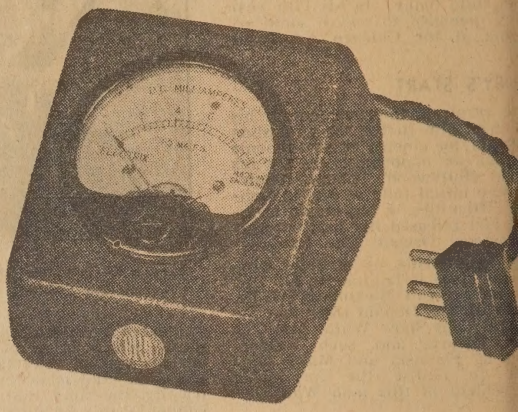

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These "cells" are the heart of the hole animation process. They save tremendous amount of work since ie background is visible through iem (except for the part occupied y the characters, of course). The ickground, therefore, need be drawn ily once for each scene.

As can be seen in one of the photo-raphs, a "multi-plane" setup is used give the illusion of depth to the cture. In some of Disney's later ics, as many as five different anes, all moving in correct relation one another, were used to achieve remarkable realism.

The cameraman has an important b requiring a considerable amount patience, since each cell must be iotographed individually a frame a time. Both the background and e foreground can be painted on ng sheets of glass and these are oved a fraction of an inch in a edetermined ratio as one cell fol-ws another.

IUSICAL EFFECTS

Thus is the story told in the image. eanwhile, the orchestra, augmented ith a formidable array of special in-ruments, has recorded the music id sound effects on a separate edium (film, tape or wire). Given e image score and a few rehearsals, lit-second synchronisation is a latively simple matter.

The dialogue can be recorded at e same time and on the same track the music, but is usually made rlier so that a separate track can made available to the animators "lip-syncing" (matching mouth vements to the speech).

The various tracks are then "mar-d," ie, brought together by an in-nious machine called the optical nter. The resulting film, usually a ster negative containing both the age and the complete sound track, hen used to make as many release nts as required.

ere in Australia many people have de animated cartoons in the past some are still active in this field. e of the most modern layouts is a small studio at Bexley North, r Sydney. Run by Eric Porter, who l best be remembered by regular o-goers for his feature film "A Is Born," it is the scene of a ular output of cartoon shorts in hnicolor for the trade, some Gov-ment departments and commercial ertisers.

JDIO SET-UP

orter at one time had a team of artists and animators working for , but found that the running of rge organisation divorced him too h from the actual art work. He ne of that peculiarly twentieth ury breed of men, an artist-hnologist, and dearly loves to put-around working out new methods devising weird but workable hines to execute his many ideas. studio set-up at Bexley, how-, is run on strictly business s. He and his staff of four enjoy advantages of working with the t and best equipment so vital in production of first-class Techni-r shorts.

he technically minded will be in-sted in the method by which er surmounts the difficulty of availability of a Technicolor era in this country. Using a dard 35mm Newall studio camera, Porter shoots his cartoons on ordinary panchromatic negative, but each color cell or frame is shot three times, once through each of three primary filters. This monochrome negative is then flown to England where it is optically printed in full Technicolor by the simple separation negative system.

Trial productions and general testing are done on 16mm Kodachrome which is processed in Melbourne. The trial production, therefore, can be shown to the client for approval before the much more expensive Technicolor prints are ordered from England.

Artist-technician Porter is busily engaged at the moment in developing several ideas he has for improving the technique of cartoon production and is looking forward with relish to the stimulus television will undoubtedly give to the Australian film industry.

So it should not be too long before we can sit around our TV receivers of an evening and enjoy, not only news of the day and Hollywood features but those great twentieth centrury relaxers, animated cartoons, from the cleverest brains overseas and equally original ones in our own backyards.

GREAT VOICES REBORN ON M-G

One of opera's most famous quintets listening to its own recording many years ago. Left to right: Leon Rothier, Andres de Segurola, and Enrico Caruso. Seated: Frieda Hempel and Maria Duchene.

Great voices of the past including those of Caruso, McCormack, Chaliapin, Ponselle and Rachmaninoff, recorded under old processes, are now being reissued in America on microgroove records by the Victor company.

THESE records, which range over a period from 1904-1937 contain performances taken from the collection of old copper masters which have lain in the recording company's vaults for many years. Their value is mainly historical, although even in the old acoustic days some remarkably good records were made.

The application of modern recording methods, however, has revitalised them, and eliminated many of the faults of the originals.

Six specialists worked over the masters sometimes with microscope and engraving tools by which, with the addition of uncanny skill, they were able where necessary to restore them approximately to their original condition.

The recordings were then transferred to tape on which the actual editing was done. The flexibility of tape allows faulty sections to be cut, scratches to be eliminated, and surface noise to be reduced, in a manner impossible by any other method.

In some cases, where several masters of the same recording were available, the best sections of each were selected and joined together so that the finished product was often considerably better than the original.

The addition of a new orchestral background, recorded so as to drown out the often thin and colorless original, completed the rebirth of the old favorites. Many old records—notably those of Caruso—have been successfully treated this way in the past.

As a result, the world will hear again some of the great voices whose owners have long passed on, and posterity will be the richer for them.

The records will be issued in both 33 and 45 rpm. Additional albums of historical popular records will also be available.

THE SOUNDS YOU CANNOT HEAR

An employee at a factory making jet-engined planes was recently reported to have "gone sick" as a result of the noises—the first case of what has been christened "supersonic sickness." We may all live to hear more of this strange melody.

'AR above the highest sound that can be heard by the human ear, even the ear of a dog or a bat, e vibrations of the same nature as ose producing all sound.

Although you cannot hear these upersonic" vibrations they have an fect on living tissues. Just what is is effect, in the case of human ings, we do not yet fully under- and. This case of reported sickness likely to stimulate research.

The study of sound and ultrasonics as greatly stimulated by its use for bmarine detection during World ar I. The first submarine locators pended upon sounds generated by e submarine itself—the noise of its otors, or even, with highly sensitive drophones, of men moving about side it.

Acoustics were used to locate sub- arines when their motors were itched off and they were making normal sound.

OUND BEAMS

One of the valuable properties of ort-wave vibrations is that they n be focused in a beam-like light. For submarine detection, the arching ship sends out an under- ater "beam" of high-frequency und. When this strikes a solid ject it is reflected in a somewhat nilar manner to light. Hydrophones tect the reflected sounds and, by rectional finding, locate the reflect- surface—the submarine.

Knowing the velocity of sound t water, the time taken for the und to travel to the submarine d back gives its distance. Correc- ns have to be made for the tem- rature and salinity of the water ich affects the velocity of sound it.

In practice all these calculations made automatically and the in- uments show the distance and mpass bearing of the reflecting face.

After the war this principle was ensively used for automatic nding of the depth under a ship. ersonic sound signals travelling wnwards are reflected from the ed and the time taken for the ible journey reveals the distance y have travelled—twice the depth water under the ship.

EAT ACCURACY

he advantages of the new type ader now used on many kinds of s are greater accuracy and the that continuous sounding can be n. Even in skilled hands the d" used for so long to take dings requires time.

he "fathometer" or echo sounder write a continuous picture of the ed. This is so accurate that a k lying on the seabed can be ted as an unexpected "bump" in readings. The *Laurentic*, among r wrecks, was located in this way—finding the ship by dragging might have taken many months.

Another application of the principle is to discover the presence of shoals of fish. The fish reflect the vibrations and record their presence many fathoms below.

It was when scientists learned to generate sounds of much higher frequencies that really spectacular results were obtained. The normal range of sounds we hear run from 40 to 4000 vibrations a second.

The limit of human hearing is generally reckoned at 10,000.

Certain animals can hear what for human beings are "ultra-sounds." A whistle can be made, for instance, which is completely inaudible to the person blowing it because the sounds generated are beyond the range of his ear, but which will summon a dog whose ear is built to hear higher sounds.

The supersonics to which I have been referring are generally in the range below 100,000 vibrations a second.

They may be generated with the aid of a rapidly alternating magnetic field. The alternations produce tiny alterations in the length of a piece of metal in the field, and this in turn creates alterations in the pressure in the air.

QUARTZ OSCILLATORS

To generate higher frequencies, the scientists turned to quartz crystals. Small slabs of crystals are made to constrict and expand by electric charges. By this means supersonic frequencies of over 1,000,000 per second have been produced.

The first phenomenon noticed with these sounds was that the shape of the liquid in the bath containing the crystal changed. The supersonic vibrations raised the liquid up into a mound and anything placed in this mound absorbed the vibrations.

by Professor

A. M. Low

For instance, when a little water is placed in it in a suitable container, the water appears to boil. If a glass rod is dipped into it, the rod appears to become hot.

What actually happens is that the extremely rapid vibrations of the rod create friction with the skin which can produce a burn—the rod itself remains almost cool.

Through a fine glass rod and by other means the vibrations can be transmitted to living tissues, and it has been found that bacteria and other simple organisms are destroyed. They are literally shaken to pieces by vibration.

Here we have on a minute scale the modern scientific counterpart of the walls of Jericho collapsing at the blast of trumpets, but in this case the walls are those of minute cells and the "blast" is that of a sound thousands of times "higher" than the note of a trumpet.

Experiments made by M. Langevin, a pioneer of ultrasonics, showed that fish might be killed by exposure to a sound beam in water for two or three minutes. In the years between the wars these experiments naturally gave rise to talk of "death rays."

Could these vibrations be created in such a way that human beings in their path would be affected?

The possibility was encouraged by reports that German workers in a high-frequency laboratory had taken ill, and that it had been discovered that their red blood corpuscles had been destroyed, and by similar rumors.

DEATH RAYS

But, in fact, a little sober consideration showed that hopes — or fears—of such a death ray was quite unfounded in the light of our present knowledge. One characteristic of ultrasonic vibrations is that they have a very short range.

Whereas an audible sound might travel for some miles, sounds with shorter wave-lengths had a very short range — a matter of a few yards. They carried very much better in liquids — hence all the experiments were carried out in oil—or water-baths. But you could hardly expect your enemy to oblige by immersing himself in an oil-bath or catching hold of a special conductor!

There was the further point that for the destruction of cells some minutes were required, and, again, whatever might be done in the laboratory, you could not expect an enemy would wait while you focused your supersonic "death ray." The possibility of a "death sound ray" was, therefore, dismissed.

EMULSIFICATION

But that did not prevent a number of interesting practical developments in the new science of supersonics. One of the effects of these vibrations is to mix "unmixable" liquids.

When the waves cross the boundary between the two liquids they overcome the resistance between them and form an emulsion. In this way water and oil and water and mercury have been emulsified.

A few years ago a patent was

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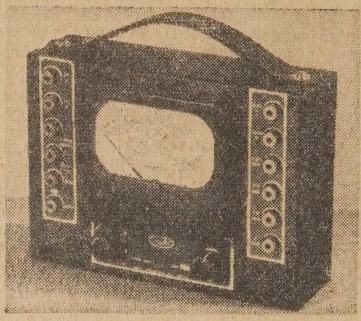

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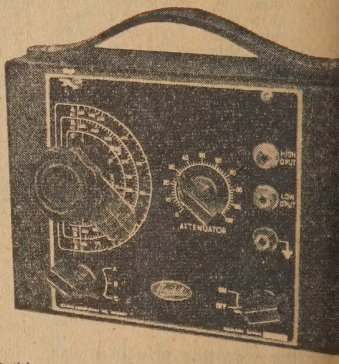
MODEL OK1 OSCILLATOR KIT



For years of active service, yet simple to build at home with a few ordinary tools, Model OK1 Oscillator Kit covers all fundamental frequencies in the average receiver. It comes to you complete right down to the last nut and bolt and assembly can be done at home with a few simple tools. The Dial, Condenser, and Coil set-up is specially pre-calibrated at the Factory so that no further calibration is necessary when you complete building this instrument.

Standard Batteries are used and each OK1 Kit is complete with an Instruction Book which gives pictures and wiring diagrams of all parts and in addition gives full operating instructions for using the Oscillator to the best advantage when you have finished it.

It is carefully packed and all Metal Parts are pre-calibrated so that no heavy work has to be done. Pleasing in appearance yet effective and simple in its use, it makes an ideal Portable Battery Oscillator for the Serviceman or Home Builder.

RADIO & ELECTRONIC TEST EQUIPMENT

University

Made by

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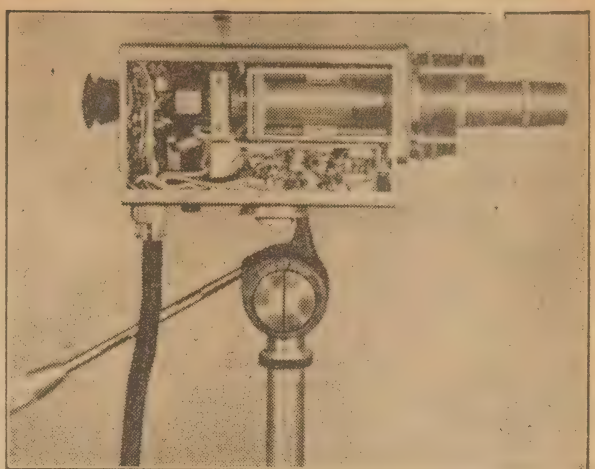
BABY TELEVISION TRANSMITTER DEMONSTRATED

A new portable television camera and transmitting station, designed to operate in the field as a one-man back-pack unit, was demonstrated recently by ... E. Flory, of the RCA Laboratories, at a meeting of the Institute of Radio Engineers USA.



Side view of the portable television camera showing the vidicon tube (upper right) and the control units. The camera has a range of one mile.

WEIGHING only 53 pounds, the back-pack station is planned to action with its own battery-power ply. It has a range of approxitely one mile.

Because of its easy portability, merous applications for the new ipment are foreseen by research ineers. Among these are news erage, with television-equipped orters flashing pictures and comntary directly to editorial rooms, remote industrial viewing and trol.

The new transmitter operates in junction with a control station ich may be located as far as a e from the camera. Signals corponding to the scene being tele-d are transmitted to the control nt on an ultra-high frequency h a power of two watts. In addi- to acting as a monitor for the vised picture, the control point forms two other functions. It ds out a stream of pulses which ronise the camera and can be d also to issue vocal instructions the cameraman.

Recent developments in the design of pencil-sized tubes and other sub-miniature component parts made possible the impressive reduction in bulk and weight of the equipment.

The back-pack is carried in knapsack fashion, suspended from the narrator's shoulders by flexible straps. Two small antennas extend from the top of the pack and are used respectively to transmit the picture signal to a base station and to receive voice and control signals from that same point.

The camera is an adaptation of the industrial TV camera using the Vidicon tube. As an added feature, the camera includes a miniature kinescope picture tube which serves as a view-finder for the cameraman. Through it he is able to see an exact reproduction of the scene on which the camera lens is focused.

The equipment contains 42 tubes which, with their associated circuits, provide all synchronising frequencies for a standard 525-line, 30-frame interlaced television picture. Included in the unit are the battery-operated power supply, deflecting circuits, amplifiers, and a radio receiver for receiving instruction and other essential information from the control point. A single battery operates the portable station for about 1½ hours.

The narrator-cameraman's voice is picked up and transmitted through the combination of a small microphone built into the camera case and an ingenious electronic circuit which adds the voice signals to the picture signals as they are radiated to the control point.

Research and development of the portable television equipment were carried out under the direction of Dr. V. K. Zworykin.

Sound we cannot hear

(Continued from Page 9)

...en out in the USA to use super-...ic vibrations to "homegenise" ...k. The "curd" tension is reduced ..., it is claimed, the milk is very ...h more digestible.

...omogenisation is also valuable in ...ous processes of manufacturing ...k. In this device the milk is pass-...through a small chamber, one ... of which is vibrated super-...cally.

...e sterilisation of milk by super-...c vibrations has been tried ...rimentally. L. A. Chambers and ...ton Gaines, in the USA, passed ...ted milk through a vessel sur-...ded by nickel which carried the ...rsonic vibrations.

...was found that all bacteria were ...royed and plans were made for ...ructing a commercial plant ...ble of "pasteurising" milk in ...way at the rate of 1500 gallons ...our.

...e advantage over heat-treat-...r is, of course, that there is no ...ation in the chemical or ...tive value of the milk. There ...e general difficulty in using ...h speed vibrations to destroy ...ria, however, that the smallest ...isms are liable to escape owing ...eir relatively small dimensions. ...igher the frequency, the smaller ...lls affected.

...er effects of supersonic vib-...ns which have been noted are chemical. It has been found that crystallisations may be started by ultrasonic vibrations and certain chemical reactions may be accelerated.

A notable instance was the production of an isocynate from acid azide. The azide was dissolved in benzine and subjected to high-frequency sound. The atoms within the molecule were rearranged, although the exact process by which this was done is not understood.

More recently Dr. Pierre Grabar, of the Pasteur Institute, has been successful in breaking down the "benzine ring," the closed ring of six carbon atoms which is the fundamental building block in organic chemistry, the basis of everything living.

The commercial application of supersonics is in its infancy, and there may be interesting developments. Laundry work is one example of tests now being undertaken. At the moment there is again a certain amount of concern whether high-frequency sounds generated accidentally can affect human beings in laboratories.

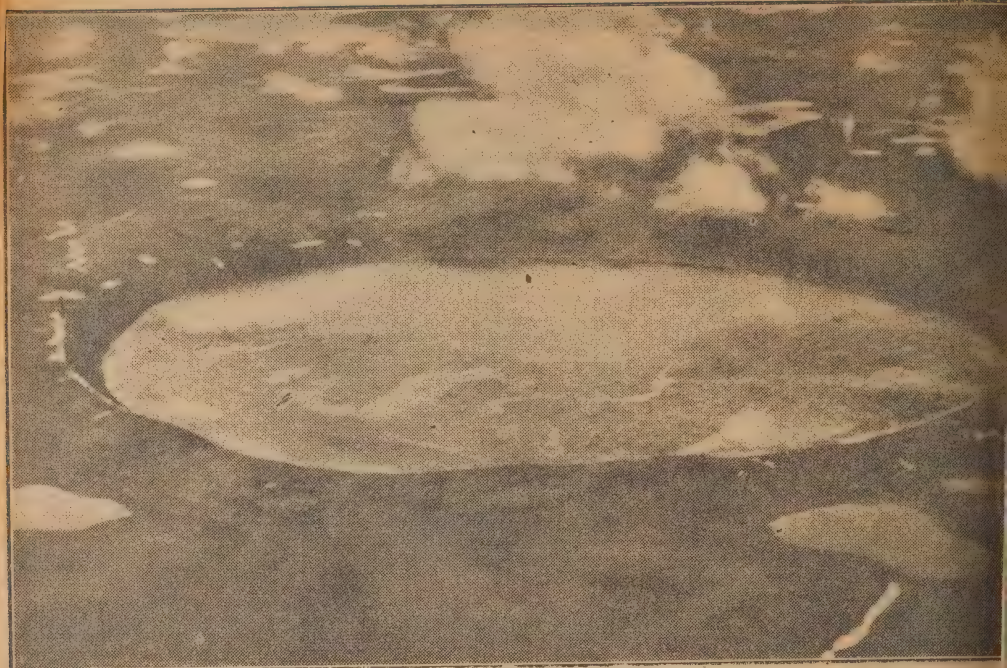
The possibility of their doing so "in the open" can, probably, be ruled out — if a jet plane passing overhead was generating high-frequency in audible sounds it is doubtful whether they would have sufficient energy to reach the ground.

Rays 'see' through iron

CANADIAN scientists have developed an instrument that could "see" through heavy metals.

The device uses radio-active iridium and needs no other power.

The National Research Council describes the instrument as being similar to but much stronger than an x-ray apparatus.



The largest crater attributed to a meteorite known to man was discovered in the north of Quebec province, Canada. It is 7½ miles in circumference, 550ft above the surrounding plains, and probably 4000 years old.

METEORS: BOMBS FROM BEYOND

It has long been suspected that the regions of the upper atmosphere hold the secret of existence. Scientists tried for ages to penetrate into the outer recesses of this heavenly canopy but it is only in recent years that much progress has been made in really finding out just what exists above our head.

by Calvin Walters

IT must not be supposed that our atmosphere exists merely for the purpose of breathing, conveying sound waves and raining. Nor does it exist solely for the purpose of propagating radio waves.

To most people a look into the sky reveals very little beyond a few clouds, few birds and a lot of aeroplanes. It appears to be entirely empty of anything which can be construed as having the remotest connection with life itself.

Yet this region, and especially that beyond the atmosphere proper, is packed with most peculiar and awsome forces.

COSMIC RAYS

For instance there are deadly rays which could penetrate our bodies and bring about the end of life on earth were it not for the benevolent protection of the atmosphere.

There is intense electrical activity which cause such phenomena as the Aurora Borealis and Aurora Australis. The activity has also a very great bearing on the propagation of radio waves.

The outer regions contain vast clouds of cosmic dust from exploded stars and other heavenly bodies.

It has never been settled whether the temperature beyond the atmosphere is hot or cold.

Some observers claim that, at about 100 miles up, the temperature is in the region of 1700 degrees Fah. Others claim that this "heat" is not the kind of heat with which we are familiar at all. That it is, in reality, a form of electrical activity of whch we have had no experience but which "burns up" anything which comes within its influence.

Meteors which rush in from outer space strike this curtain of "he and burst into a consuming fla which completely gasifies the sm lest of them and reduces the lar ones to dimensions that will be co paratively harmless.

True, many meteors reach e earth but there is no evidence wh suggests that any person has b struck by one.

EVIDENCE OF HEAT

It has been observed that th meteors burn at a much greater than they should, were the tem ature above our atmosphere as as we have hitherto thought.

Yet, in 1936, Professor Vegard ried out experiments by spec scopic analysis of Auroral li which indicated that these bur streamers were active in air w was at a temperature of some degrees below freezing point C grade.

It would appear therefore that "burning" activity is, in reali peculiar form of electrical act

familiar to every - day earth
ellers.
Fortunately for us the atmosphere
otects us against the ravages of
h forces and acts like a filtering
tain against the activity of deadly
mic rays.
t is not only the atmosphere which
ords this protection but the very
olution of the earth on its axis
eeps dangerous radiation to the
les where these electrical and
gnetic disturbances manifest
mselves in the form of magnetic
rms made visible in the Aurora
realis.
t would seem that life at the
les would be impossible of con-
uance, not only because of the
ense cold but because of the ad-
se effect of these radiations from
er space.

FECT ON HEART

Experiments at the South Pole
ve shown that, prior to a magnetic
rm, the human heartbeat falls to
ost half its normal rate. This is
) attended by a nervous condition
led Arctic Hysteria.
hese conditions make their ap-
rance as much as 48 hours prior
a magnetic storm.
Vith the advent of increased
ilities for investigation of the
per air we are learning more and
re of the conditions up there.
h facilities include the V2 rocket
de notorious by the Germans in
rld War II in the bombing of
ndon. This fearsome weapon has
n turned from war to the paths
peace—while there is "peace"—
has been sent up well over 100
es equipped with the most fan-
ic instruments for measuring
ost anything.
n fact, it is nowadays much
ier to investigate the upper air
n it is to find out what exists far
vn in the earth.
Considerable interest exists in the
dy of meteorites which come to
from outer space as specimens of
vhat?
are they the remnants of planets
g ago disintegrated by those same
ces which brought them into
stence? Do they furnish us with
dence of the mechanism of
ation? Are they the primordial
tter out of which the universe
s created?

TEORITES

t has been known for countless
s that meteorites are composed
efly of stone and iron although
the ages of primeval man these
stances were not known as such.
t the present time, however,
e different elements have been
overed in these cosmic visitors.
uded in these is the metal mag-
um which probably explains the
ion for their brilliance when they
st into incandescence in our
losphere.
nother metal very common in
eorites is nickel which combined
n iron forms a very heavy metal.
ow it has been deduced from in-
igation of the earth's structure
it contains a core of nickel iron.
therefore reasonable to suppose
the fragments of nickel iron in
meteor are fragments of the core
planet which once existed in our
system somewhere between the
h and Mars.
this be true, the study of them
the utmost significance to us, if
only for the reason that we would like to know whether the same fate is in store for us in some future age.

It is true that we can do nothing about it even if we can prophesy with any certainty such a disaster. It would be useless finding a cave in a mountain to hide in. It would be useless hoarding up money in kerosene tins or scarce commodities such as butter, motor tyres and bottled beer. It would be nice to know anyway—or would it?

POSSIBLE FLAW?

Maybe there was some flaw in the construction of our erstwhile planetary companion. But even if we found one in our earth it would be useless filling the crack with cement. Cement can't be bought these days anyhow.

There has been no evidence that our exploded companion harbored any kind of life although in 1934 an American scientist laid claim to the discovery of germs inside a meteor. The "disovery" was not confirmed. Perhaps he confused his "meteor" with a lump of stone from a garbage tip.

No one has ever found a footprint, a fossilised old boot or the remnants of an income tax return in a meteor, so that whether life existed on this defunct planet or not, is just a matter of conjecture.

We know that this old planet must have been historically far ahead of us for it had disintegrated long before our earth had resolved itself into a place fit for the maintenance of life.

It may be that some day some large fragment will fall to earth containing evidence which will tell us of the forces which brought about its destruction. Perhaps the life, if any, which existed on it discovered the secret of the disintegration of the atom and brought about what we ourselves may bring about. —the complete destruction of civilisation and of the earth itself.

In connection with exploding stars there is increasing evidence that the number of stars which explode in the remote regions of space is steadily increasing.

There is evidence that the universe itself is changing and is not the fixed cosmos we once thought it to be. Things are speeding up and every now and then our telescopes reveal awful and devastating explosions millions of miles from us—fortunately.

These explosions have been witnessed ever since astronomy began and even astronomers are shocked at the cataclysm of an exploding star.

These stars are called Novae and complete mystery surrounds the circumstances of these heavenly "bombs."

In outer space are stars called Cepheids which pulsate with a regular

(Continued on Page 83)

A lucky shot with a ranger camera produced this picture of a meteorite in Mexico, 1933. It is the best of the few in existence.

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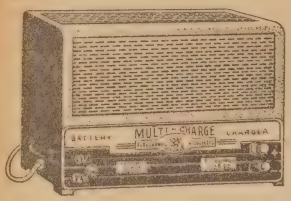
—GET THEM FROM WARBURTON FRANKI



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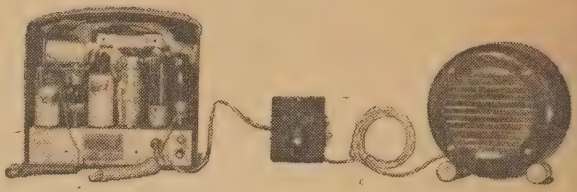

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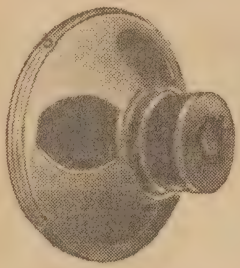

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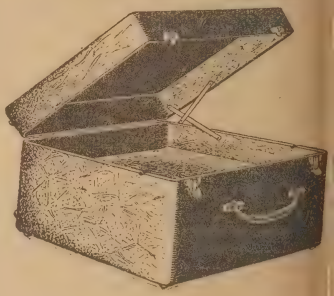

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Technical Review

SENSITIVE RADIATION DETECTOR MAKES NEWS

The latest of the so-called semi-conductors to make the news is cadmium sulphide (CdS), which promises to become an important research and industrial tool because it can be made a very sensitive detector of various types of radiation. It will be especially useful for high-speed automatic x-ray inspection of industrial products.

THESE photo-sensitive CdS crystals are sensitive to both electromagnetic radiation (from the yellow region in the visible spectrum up to x-rays and gamma rays) as well as to high-energy particles (electrons, protons, and alpha particles). A polarizing voltage applied to the crystal makes it sensitive to radiation and, over a rather wide range, the photo-current is proportional to the applied voltage. (The electrical resistance of the crystal also varies with the intensity of applied radiation, but this is not always linear.)

Most important is the fact that the photo-current varies from crystal to crystal. In some crystals the photo-current corresponds to the number of free electrons produced in the crystal by a second (as in ionization chambers, while mothers the sensitivity may be as much as a million times greater.

The photo-current persists for a short time after the radiation is stopped. Generally the persistence is greater with greater sensitivity. In some insensitive crystals the conductivity may decay within a microsecond after excitation stops, while in sensitive crystals the decay time may be measured in seconds or even minutes. In crystals where the photo-current is not proportional to the exciting radiation, the persistence still depends largely on the amount of excitation energy.

The CdS crystals also emit a reddish glow when irradiated. The amount of glow varies from crystal to crystal. The more sensitive crystals have a greater output of light, while weakly luminous ones produce only a small change in conductivity. This fact is most important, because it means that crystals may be selected for any particular use before they are fitted with electrodes.

HOW IT WORKS

The reason for this unusual optical and electrical behavior of these crystals seems to depend on dislocations in the crystal lattice.

In simplest terms, a crystal of any kind is different from other forms of matter because the atoms which make it up are arranged in orderly geometric patterns.

Even extremely small dislocations in this structure seem to have a great effect on the luminescence and conductivity of these CdS crystals. To make crystals with specific properties, it is advantageous to produce these dislocations systematically.

When the crystal is not excited by radiation, the electrons are firmly bound to the atoms within the structure and there are no freely moving charged carriers to make up a current. When radiation is applied, some of the electrons absorb enough energy to be able to break away from the atoms and, if a polarizing voltage is applied to the crystal, a current flows.

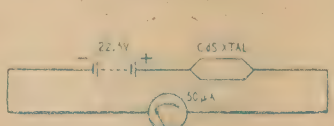

Fig. 1.—Simple detector circuit using the crystal. When radiation hits the crystal, current through meter jumps.

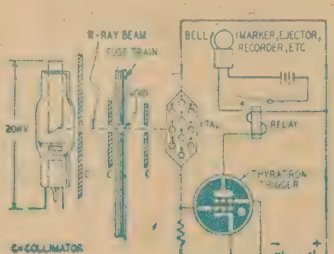

Fig. 2.—Setup for testing powder continuity in a fuse train. Fuses can be checked as fast as 60 feet per minute.

During this high-energy state, each electron that leaves the crystal at the anode is replaced by one that enters at the cathode, so that the amount of current depends on the number of electrons that are in the excited state.

After a time (depending on the type and number of defects in the lattice) the excited electrons return to their normal state. In this process the energy which they picked up during radiation is emitted as luminescence.

Luminescence and conductivity are thus closely related. The relation between sensitivity and persistence also becomes clear with this explanation.

Because it is highly sensitive even in the simplest of electrical circuits, the CdS crystal makes a good detector of all types of radiation. A CdS crystal hooked up to a single battery and an indicating meter can detect radiation intensities so weak that would otherwise require considerable apparatus.

The circuit of a pocket size radiation detector shown at Fig. 1 consists merely of the crystal, a 22½-volt hearing-aid battery and a microammeter. This device was built by Immanuel Broser and Ruth Warminsky at the Kaiser Wilhelm Institute in Germany.

The smaller unit to the right of the meter case is a crystal holder. A small cylinder inside the holder takes several crystals, and any one may be selected for use by turning the cylinder so the crystal is in front of a small window.

The crystal holder is separate so that the instrument can be read at some distance from the actual point of measurement to protect the operator from harmful radiation.

In this detector the crystal can be selected for a variety of uses. For example, one is for measuring light, another is for measuring the intensity of x-rays, and a third is for detecting weak gamma rays. This gives even this little pocket instrument an extremely wide range.

The instrument could be made even more sensitive by using a higher-voltage battery. The only thing which limits the amount of voltage that can be applied to the crystal is that it begins to heat up when too much current flows through it.

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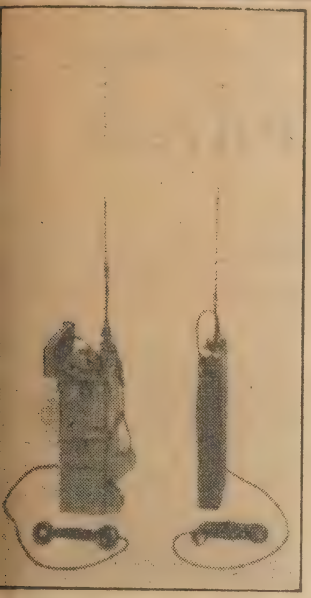
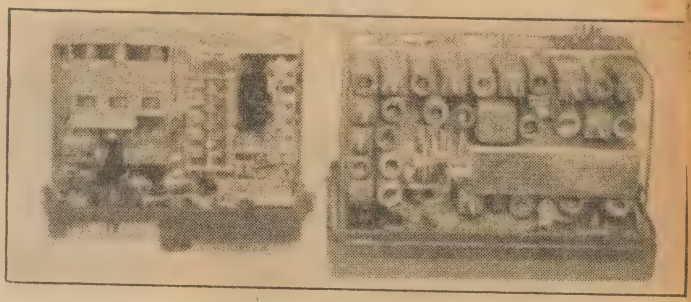


Comparison of larger old model with the new at right. Transmitter-receiver unit is in top case, power supply in bottom.

Reduced size of ganged tuning capacitor is shown at left as compared with old unit at right.



Side-by-side view of new chassis on left and old at right. Miniature components and compact construction permit packing 16 tubes into new model with resulting reduction in size and weight.

Miniaturisation of radio components and assembly has been carried to almost miraculous limits in the latest walkie-talkie developed by RCA for the American forces. Such equipment has always provided a challenge to ingenuity, but the AN/PRC-10, as the new equipment is termed, far outstrips any previous efforts.

'HE unit, which contains 290 components furnished by 181 suppliers, went into production under a priority calling for completion of initial sets in 44 weeks, compared with the 55 weeks normally allowed for such a job. Engineers and production men worked closely together to complete the work in less time. They did it in 36 weeks.

Many things were involved in the production of the needed unit in a hurry. Among them, the following stand out: Expediting, subassemblies, miniaturisation and dip soldering.

Subassemblies consisting of complete i-f and f-m discriminator stages have been reduced in size so that they can be contained in a metal cylinder about the size of a single miniature tube.

Germanium crystal diodes are used in place of tubes where feasible, and miniature tubes are used elsewhere except for the power output tube, which is of miniature size. Tiny circuit components such as transformer coils less than a quarter-inch deep and half an inch in diameter, yet having a Q near 100, necessitate the use of magnifying lenses by workers on the production line.

One of the most important manufacturing techniques used to turn out the equipment in a minimum of time is resistance-weld type soldering employed in the i-f stages and other small components.

The AN/PRC-10 is half the size and weight of its predecessor and has twice the range. The transmitter-receiver unit is 9½in high, 10½in wide, 3in deep and weighs 9lb. The entire equipment, including power supply and spare parts, weighs only 25lb. Reduction in size and weight has not only made the set more portable, but has also effected savings in critical materials.

The new unit has increased stability which permits operation of many more walkie-talkies in a given area without interference than could formerly be tolerated.

Provision is made by the 16-tube equipment for two-way voice communication over a range of about five miles on frequencies within the vhf band. It can be used as portable gear strapped to the back of the operator or as a semi-permanent installation in a vehicle or on the ground.

Remote operation and unattended

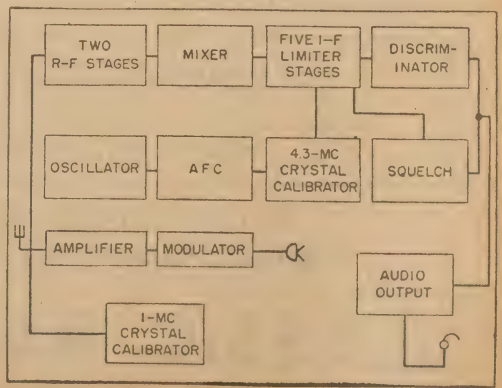


Fig. 1—Block diagram of the AN/PRC-10 walkie-talkie. Effective range is about five miles.

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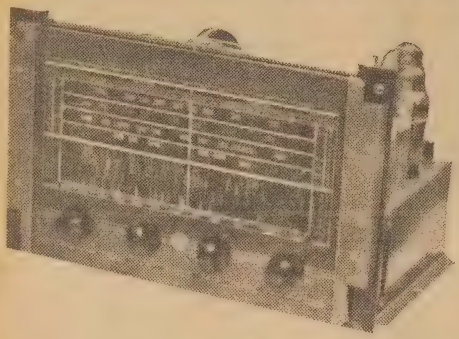

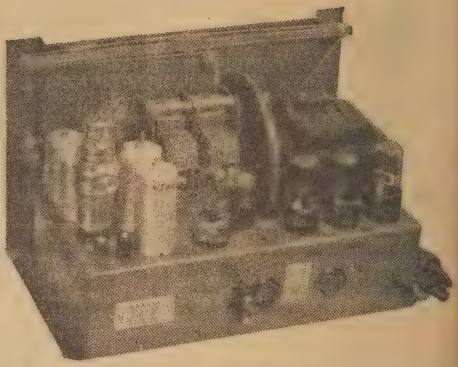

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6 VALVE WORLD-RANGE CHASSIS

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CLASSIC RADIO

245 PARRAMATTA RD.
HABERFIELD.
PHONE UA2145.

lay operation are important fea-
res made possible by using two
nits back-to-back, with intercon-
ections enabling them to pick up
nd retransmit messages in both
irections. This type of operation
nables communication to be estab-
shed between two stations separ-
ted by high ground by having two
lay sets located on the interven-
g elevation.

The equipment is housed in two
aterproof cases, held together by
ring clamps. The top case con-
ins the receiver-transmitter unit
nd the bottom case the battery pack.
n eight-wire cable connects the
ansmitter-receiver with the battery.

Transmitting and receiving circuits
e both adjusted to operating fre-
uency by the same tuning knob.
he dial-drive mechanism is an
ntibacklash gear train with the an-
nna tuning components mounted on
nd operated by it. Other important
djustments are the volume and
quelch controls.

UB-ASSEMBLIES

The RF mixer and oscillator cir-
uits are individual sub-assemblies
onsisting of decoupling resistors, a
nall coil, capacitors and a sub-
iniature tube and socket. Each sub-
ssembly is located in a small box.
he antenna coil is common to both
ansmitter and receiver.

Each IF amplifier subassembly in-
udes the tube and is hermetically
ealed in a can about ¾ of an inch in
iameter and 2 inches long. The cans
e made with 7-prong plug bases
hich plug into sockets on the chas-
s. A similar can contains the dis-
riminator unit which uses two
ermanium diodes instead of a sub-
iniature tube.

Two types of antennas are provided
ith each equipment. For maximum
nge, stationary use and two-way
ttended relay operation, a seven-
ction whip-type antenna is used.
ch section of this antenna fits into
e ferrule of the previous section.
protect the long antenna from
mage by bending if it should strike
object, a spring-section is pro-
ded.

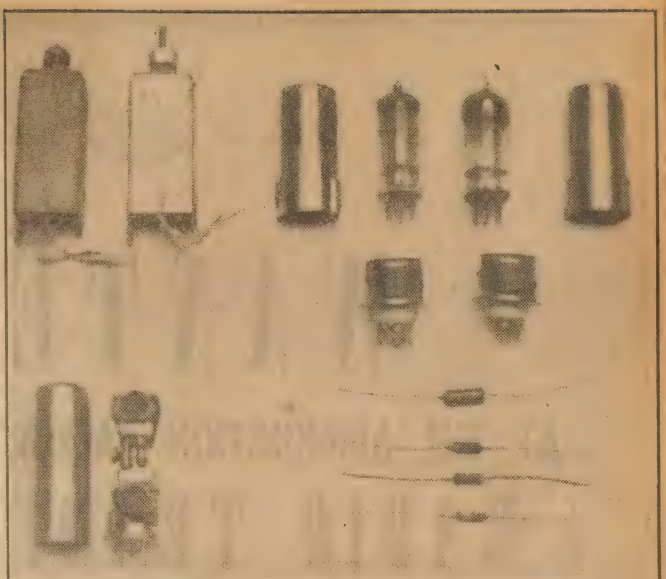
For general operation, a short
mi-rigid steel antenna is used,
ade up of lengths of flexible steel
be riveted together at the base and
various points along the length
the antenna. This tapered antenna
about three feet long and can be
ded into a small area without
mage.

RFORMANCE FIGURES

The receiver sensitivity is 0.5
icrovolt with 2.5mw output, 15kc
viation and a 10-db signal-to-noise
io. Selectivity is 80kc at 6db down.

A received signal is resonated in
th the antenna and the antenna
il and then amplified in the two
F stages gang-tuned to the oper-
ng frequency. The amplified RF
nal is fed to a mixer stage to-
ther with the local oscillator signal
produce the intermediate fre-
ncy in the plate circuit of the
xer.

Five identical cascaded IF stages
llow the mixer and are connected
grid limiters. If the signal from
e mixer is strong enough, the IF
ages operate as cascade limiters.
Following the five IF stages is a



New US Army walkie-talkie discriminator assembly and cover at lower left replace all the other pictured discriminator stage components used in old model.

discriminator and a single audio stage feeding the handset receiver.

When no signal is being received and the squelch circuit is turned on, the discriminator output is shorted by a relay operated by the squelch tube. This tube is controlled by the grid voltage of the last IF limiter. The grid voltage cuts off the squelch tube, releases the relay and thereby removes the short on the audio input.

The equipment is calibrated by two crystal-controlled oscillators. The constant-frequency output of one oscillator feeds into the antenna coil. Certain harmonics of this oscillator frequency beat with the intermediate frequency of the second calibration oscillator to produce a calibration signal at every megacycle point on the calibration dial.

The transmitter contains an electron-coupled oscillator whose frequency is controlled by comparing it with the local-oscillator frequency of the receiver. The antenna coil common to both the transmitter and receiver makes up the output circuit for the transmitter.

Frequency modulation is accomplished by varying the magnetic flux through the ferrite core of an inductance coil shunting the grid coil in the tank circuit of the transmitter. The microphone signal and the constant output voltage from the AFC circuits are both fed into the modulator stage.

ELECTRONIC COMPUTER

LOW cost electronic computers are now in use in several departments of the Boeing Airplane Company solving aviation dynamic problems in a week that would take a year by older methods.

There are now many types of electronic computers, often called giant brains, in use but most of them are costly and complicated devices that must be used in computing centres.

This new type is cheap and simple enough to be used in individual engineering rooms where problems in dynamics are solved. A competent engineer in dynamics can learn to operate it in one day.

The new instrument is a simplified form of a large analogue computer put into service a year or so ago. The parent device solves problems relative to how a proposed plane or missile will behave in the air even before actual construction begins. The smaller version is so simple that it is described as a companion instrument to the slide rule.

ELECTRONICS IN SURGERY

A NEW machine to help doctors locate brain tumors and follow thyroid conditions under treatment with radioactive iodine was shown at a joint conference in New York of the American Institute of Electrical Engineers and Institute of Radio Engineers.

Instead of using a Geiger counter to detect radioactive chemicals injected into the body for diagnostic purposes, the new machine uses a scintillation counter. Tiny flashes of light, instead of the more familiar clicking sounds, signal the radioactivity. A special electronic circuit counts the flashes.

The new machine is a compact instrument packaged in a unit to be plugged in and provide immediate diognostic answers.

Our modern word "electricity" comes from the ancient Greek name "elektron" or amber, which was found to pick up straws if rubbed.

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NEWS AND VIEWS OF THE MONTH

A great organist

ONE of the highlights of this musical year has been the visit of r. Thalben-Ball, the famous Engsh organist.

Australia has some fine organs, but nfortunately very few who can ay them with any authority. Great rganists are far and few between, nd our visitor has shown us in erson the difference between a cometent player and a master.

The organ is one of the most fficult instruments. Apart from e obvious demands on musicianip, it calls for exceptional coordination between brain, two hands, nd two feet, plus lightning calulation and speed in arranging and e-arranging the many combinations ossible with a multi-manual instruent.

And when these problems have been faced, there is the sheer physical effort involved in putting intention into practice.

But Dr. Thalben-Ball makes it all seem so simple. The music flows from his instrument easily and surely, with no evidence that the mechanics of the matter are of the least embarrassment to him.

Some of his best work has been heard in the Handel organ Concertos in both Sydney and Melbourne. I doubt whether we have ever heard an organist who commands such sure outline, such amazing flexibility and dynamic shading, and such musicianship.

BIG PIPE

It's interesting to note that our visitor has not previously played an organ with a pipe as large as the 64ft mammoth of the Sydney Town Hall organ.

This isn't as surprising as it sounds for the Sydney organ is one of the largest in the world. How far down on the list it is today is hard to say, but it is probably still among the world's big six.

Unfortunately it still has pneumatic action — most noticeable in contrast with the Melbourne organ which is electric. During the broadcast performances, the action of the Sydney organ could frequently be heard quite plainly.

Comparing the concerto performances in both Sydney and Melbourne — and Thalben-Ball played the Handel No. 10 in each—the better balance of the Melbourne hall was most noticeable. It has of course less echo than Sydney, and the musical outlines were as a result much better, as was the general

POPULAR SCIENCE QUIZ

Q: What is meant when a substance is described as being elastic?

Briefly, elasticity is the ability of a substance to return to its original shape after it has been deformed. If you take an "elastic" band, stretch it, and then remove the stretching force it will return almost to its original condition. If you had some accurate means of measuring it you would find that there had been some small permanent deformation of the rubber.

On the other hand if you take a length of glass rod and exert a bending force subsequently removing it you would find that there had been practically no permanent deformation. Glass is a highly elastic substance.

Commonsense will tell you that while the elastic band may be stretched to two or three times its original length without breaking, the glass rod can only be bent a very slight amount without breaking. To put it into scientific language, the glass has a much lower elastic limit than the rubber.

In contrast with an elastic substance, a plastic substance is one which retains the deformed shape given it by an external force. One of the most plastic substances at normal temperatures is clay. If you push your fist into a block of clay it will retain the shape of your fist rather than spring out to its original shape as would a block of rubber.

Air is an elastic substance. It is the air in the tyres which gives you a smooth ride in a motor car. The rubber and cord from which the tyres are made is merely designed to be strong and flexible. When the wheel hits a bump the air in the tyres compresses but immediately expands to its original volume and resumes its original pressure.

If there were such a thing as an inelastic gas and a car tyre were filled with this gas it would stay compressed after hitting a bump and the pressure would [illegible] down while the density of the gas would go up. After a couple of bumps you would have a flat tyre.

Q: If you drop a stone from a building, what happens to the energy that was used in carrying it to the top of the building?

The question arises from the principle of conservation of energy which states that energy can neither be created nor destroyed but only changed in form.

Considering the statement applied to the particular case of the man carrying the stone to the top of the building and then dropping it, we begin with chemical energy which comes from the food he eats and which is converted by his muscles into mechanical energy.

After the muscles have raised the stone to the top on the building they have imparted to it a special type of mechanical energy.

When the stone falls it gathers speed and the body is given another type of mechanical energy. The important point is that the total mechanical energy possessed by the stone is exactly the same during the whole time it is stationary and when it is moving until the instant before it hits the ground.

At this instant most of the mechanical energy is changed into heat although a little goes to sound, &c. If you were to measure the temperature of the stone before and after the drop you would find that it had risen slightly.

Most of the heat is quickly dissipated by the ground and air so that it is very difficult to collect but if it could be collected and applied to a 100 pc efficient steam engine the engine would convert the heat energy back into mechanical energy and the mechanical energy could take the stone back to the top of the building. If everything were completely efficient the cycle could go [illegible]r ever.

Q: What do the weather men mean when they say that the humidity is 100 pc?

Unless special laboratory precautions are taken to make it otherwise most of the air on the earth contains a certain amount of water vapor. Naturally the amount tends to be greater near the coastal regions and over the sea. When it is raining the amount of water vapor, along with liquid water, contained in the air is very high.

The amount of water vapor the air can hold is connected with the temperature at the particular time. When the temperature is high the air can hold more water vapor than it can when the temperature is low.

This leads to the idea of relative humidity the figure for which is usually quoted in the weather reports and is the ratio of the amount of water vapor in the air to the amount of water vapor that the air is capable of carrying at the same temperature.

Relative humidity is quite distinct from absolute humidity which is a simple statement of the weight of water vapor in the air at the time. For instance, you could say that the air contained so many grams per cubic metre. The temperature could rise without having any effect on the absolute humidity but a rise in temperature would reduce the relative humidity since the air is capable of holding more water in vapor form at the higher temperature.

It is interesting to note what happens when the temperature falls. First of all the relative humidity increases but eventually it reaches 100 pc and the air cannot hold any more water vapor so that the excess vapor turns into liquid water.

Throughout the day heat from the sun causes a lot of liquid water to be vaporised but at night there is quite a rapid fall in temperature and the air cannot hold the vapor which turns back into the liquid form.

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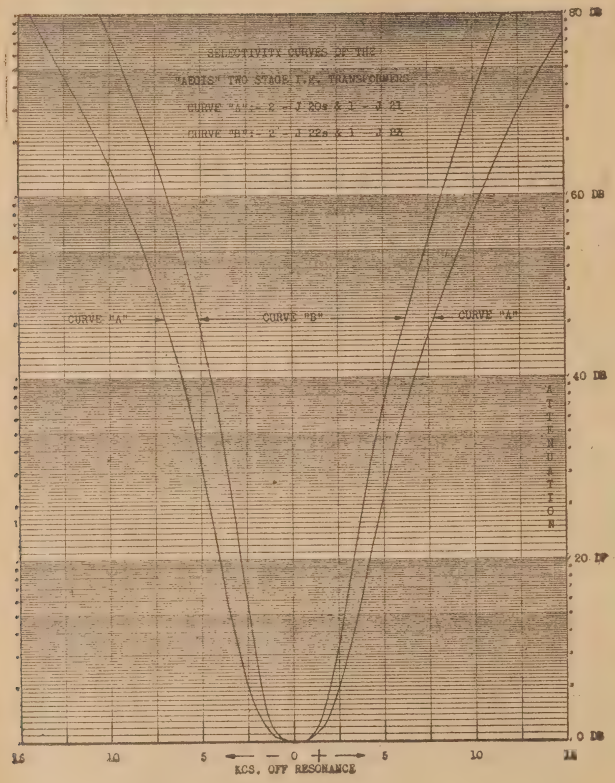

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lance between organ and chestra.

At the same time, there is little ubt about the sheer weight of the dney organ. Even over the air made the so-called "mighty Wurzers" sound like barrel organs. We don't hear enough of Aushia's organs. Maybe these outnding concerts will do something stimulate a greater interest.

RECORDING

The Sydney performance of the ncerto No. 10 was recorded by e ABC and played back later in e evening. It was so good that e wonders whether a recording uld not be made of it. Goossens s already started the ball rolling th Corroborree, and it would be other landmark for the Sydney chestra if its magnificent perrmance could be transferred to sc, or another recording made if e one or two slight blemishes ere considered undesirable.

It is certain that such a performce would stand comparison with y organ concerto yet released. On icrogroove it would take no more an a single 12in side.

The prying eye

ONCERN is expressed in the US that the televising of important arings and court proceedings is ving an adverse effect on them. It is claimed that a biased imession is obtained by the television dience which might see only part what goes on. Those engaged the proceedings are at a great sadvantage in having to worry out what the outside world sees d hears.

Moreover there is the legal aspect whether or not it is an infringeent of personal rights to televise citizen without his consent while dergoing the strain of appearance court or elsewhere.

Many prominent people object ost strongly to the danger of being ught by the roving eye of the levision camera when they do not now about it. In this respect the mera is in quite a different catery from the microphone, for it quite practicable to televise from hundred yards or more with good tail, and no notice.

Recently one of the Royal family as caught by a television camera hile surreptitiously scratching herlf at a race meeting. Many conder that such things might, under rtain circumstances, be the basis r a libel action.

To a certain extent, the invasion radio into our Parliament has t been altogether a good thing. any speeches have been given purely r the benefit of listeners and the sirability of making an impreson on an electorate, rather than contribute anything useful to a bate. And many of the incidents nich have gone over the air have questionably reacted strongly ainst the dignity of the Parliaent.

What might happen when a telesion camera is installed only the agination at present can estiate. Nor is it certain that even rliamentarians should be subjected the ordeal of being projected into ousands of homes, sometimes with-t their knowledge.

At the present time it looks like major headache for television in e USA.

Let's Buy An Argument

As I had expected, the reference in the June issue to aural distortion, beat notes and the like, brought forth a deal of comment, most of it along anticipated lines. One letter, however from Mr. J. F. McDermott, did cause a furrowing of the brows. What arises from it all, has only a second-order connection with radio theory but that maybe isn't a bad thing for once.

by W. N. Williams

AT first reading, I might well have reacted like a certain well known character . . . "Oh, I say, I am a fool."

However, after re-checking a few ideas, I have reason to hope that I mightn't be one after all, evidence to the contrary notwithstanding! At least I had been wise enough to approach with caution a bit of territory which is the stamping ground of at least three interested parties — musicians, medicos and radio engineers.

Each group has its own independant ideas and, for good measure, some confusion arises from terminology. In fact a good deal of Mr. McDermott's letter hinges on this very point.

Thus, I am informed that "Your discussion centred on combination tones, which you erroneously referred to as beats."

I agree that it may look like an error from Mr. McDermott's point of view but the word "beat" is employed every day to describe the equivalent electrical effect. It is therefore the natural one for radio folk to use. (cf beat-frequency oscillator, zero-beat, &c.)

I could equally well have referred to "heterodynes" or even "intermodulation," thus avoiding confusion with apparently accepted acoustic terminology. The word "apparently" is inserted quite deliberately, because I have reservations about the validity of the "popular" definitions for some of these terms. Maybe it's not so much what they say as what they don't say!

But let us accept the amendment for the time being and describe as "combination tones" the products of a simple heterodyne mixture of two frequencies in the presence of admitted non-linearity. Where does it lead us?

Curves have been published which show the approximate relationship, for the average ear, between frequency, sound intensity and the or set of harmonic stimuli and com bination tones.

The words "approximate" ar "average" cover a multitude of sin for there is room for error and in terpretation in data which seeks relate physical phenomena to bra stimuli. In addition, our aural equi ment is notoriously inconsister from one person to the next. It vari also with age and with health.

However, it becomes apparent th non-linearity is present in th "average" ear for sounds of qui MODERATE intensity. This is pa ticularly true at the lower freque cies.

LOW FREQUENCIES

Taking an extreme case, it wou appear that all harmonics up to th fifth are produced by the ear whe listening to a 50-cycle note at level equivalent to 20 db above th threshold of hearing. And 20db abo the threshold of hearing is common described in textbooks as an avera whisper! (What price all this ta about pure organ bass?)

At middle frequencies, the ha monic threshold rises considerab but still not far enough to lift the "average" ears above the non-line region for everyday sounds ar listening.

I can only conclude that the phra "high intensity," as applied to t appearance of combination tones, misleading, to say the least. I w have more to say of this anon.

It is sufficient to suggest now th combination tones (in the str acoustic sense) are generated in t ear structure at even medium sou intensities. They have frequenc equal to the sum and difference the original frequencies, in accor ance with ordinary heterody theory.

The number of combination to naturally multiplies with the numb of original frequencies. It must stressed that components can int act which, on their own, would handled quite easily by the ear. know, from ordinary amplifier a speaker practice, that a single frequency component, sufficient "overload" the system, can affect linearity for all other present co ponents.

It doesn't follow that an obser can pick out or classify individ effects, even under test conditio If he could, there would be no n to resort to an "exploring" tone, mentioned by Mr. McDermott.

However, as I pointed out in

June issue, the net effect on the listener of adding to the tone structure is to modify the overall timbre or character of the sound, making it variously pleasing or displeasing, as the case may be.

It may even change the apparent loudness of the sound. Recent experiments in America have indicated that the distortion content of reproduced music (as expressed as a percentage of intermodulation) has a direct bearing on the sensation of loudness, even though the distortion may not be obvious as such.

It is certainly true that these observations were based on deliberate distortion at the sound source, external to the ear. However, it is reasonable to expect that similar stimuli would result from the same kind of distortion arising from the ear structure itself. It may well be that the intolerance of some folk to moderately loud music is attributable mainly to this effect.

THESE "BEAT" NOTES

And this brings me, in turn, to the subject of "beat" notes, taking the word in its acoustic sense.

I find reference to two kinds of beats, firstly those between notes very close in frequency and, secondly, those between notes which approximate simple musical intervals.

Concerning the first type, I can only say that the difference between them and combination tones is completely lost on me, because they are covered by the same definitions. They are in fact, the same thing, being plain, ordinary, everyday difference frequencies which happen to have low, a readily audible, beating rate.

Far more significant is the inference which must be drawn from them relating to basic distortion in the aural system.

In his Elements of Acoustic Engineering, H. F. Olson, EE, PhD, says:

"Combination Tones and Non-linear Transducers:—In most of the discussions of this book, the elastic restoring force of the elements of a vibrating system have been considered to be proportional to the first power of the displacement. If a second power term is included the element is assymetrical, the restoring force being different in magnitude for positive and negative forces. According to most investigators, the structure of the ear is of such an asymetrical character.

"Combination or sum and difference tones may be produced in any non-linear system as, for example, an intense sound in the air, in the throat of a horn, by overloaded vacuum-tube amplifiers, by diaphragms and by suspension systems."

ANOTHER QUOTATION

Referring to "beats," the same author says:

"When two tones of nearly the same frequency are sounded together, they produce beats at a rate equal to the frequency difference between them. In the case of very slow beats the intensity seems to rise and fall continuously. Faster beats appear as intermittent impulses."

In the face of that, I feel about as guilty as someone who has inadvertently referred to a motor car as an "automobile." And, indeed, if one should suffer incarceration for such an offence, I will have distinguished company.

In his book on Magnetic Recording, S. J. Begun, Chief Engineer of the Brush Development Company writes thus:

"Another manifestation of the peculiarity of the ear is its ability to hear 'beats.' Beats or combination tones are the sum and difference frequencies when two pure sinusoidal tones of different frequencies and sufficient intensity are heard simultaneously."

Now I want to take up again this matter of "sufficient intensity." In relation to low period beats it is

BEATS AND COMBINATION TONES

Well really, sir, I must protest. Reference your comments on "beats"—"R & H," June '51.

You are obviously unaware of (1) the nature of beats and (2) phenomena arising from the presentation of two tones to the ear.

When two tones are presented to the ear one or more of the following phenomena will arise: beats, combination tones, interference and masking.

Your discusion centred on combination tones which you erroneously termed "beats."

Combination tones are tones arising from the presentation of two tones at high intensities to the ear and whose frequencies are the sums and differences of the primary tones and of their simple multiples.

The phrase "at high intensities" is of foremost importance for this phenomenon is only to be observed in the presence of non-linearity and a graphical representation of the intensity function for the cochlear response of the ear has been shown to be linear only to certain intensities after which it bends.

Under ordinary conditions only a few of these combination tones may be observed without the introduction of a third "exploring tone" which will beat with an expected combination tone. Which brings us to the subject of beats.

Beats are of two kinds, known as beats of imperfect unisons and beats of mistuned consonances. whose frequencies differ only The first arise from two tones slightly and the rate of beating is simply equal to the frequency difference. Beats of the second type appear when the two primary frequencies depart slightly from some simple interval relationship.

For example consider the two frequencies 200 cps. and 302 cps. which approximate a musical fifth with a ratio 2:3. If these two tones are presented to the ear beats will be heard beating at the rate of four beats per second. (Rate of beating equals mM - nM where m:n is the simplest perfect ratio of the interval and M and N are the actual frequencies of the tones.

So in the example:—M:N equals 2:3 and M equals 200 N equals 302.

Therefore, Rate of beating equals 2 X 302-3 X. 200.
equals 604 - 600
equals 4 beats/sec.

Slow beats are heard as surgings in which the periodic rise and fall in the intensity of the sound is the prominent feature. With faster rates of beating we hear merely a succession of distinct and seemingly momentary pulses. Finally, with still faster beats we hear only a rough whirring of sound.

The phenomenon of interference is a recent discovery and is as yet known only in the electrical activity of the cochlea. It appears as a reduction in intensity of one tone on the presentation of another. The conditions necessary to the observation of this phenomenon are highly complicated but briefly the method is as follows.

A tone is fed to the ear and the magnitude of the electrical response is measured with a waveform analyser set to the frequency of the primary tone. A second tone is introduced and the magnitude of the first tone noted. If the interfering tone is raised to a sufficient intensity, the magnitude of the response to the measured tone will suffer a reduction. Reductions of up to 30db have been observed.

Interference occurs between any pair of tones irrespective of their frequencies. However, frequency is not irrelevent as it has a significant relation to the degree of interference. Speaking generally, interference is greater for tones to which the ear is most sensitive.

Masking occurs when the two tones applied to the ear are similar in frequency but one is much stronger than the other. The stronger tone will reduce the loudness of the other even to the point of preventing its perception altogether. Masking is quite distinct from interference for whereas interference occurs with any two tones masking requires that the tones be in the same general region of frequency. The amount of masking depends upon both the frequency and the relative intensities of the tones.

Well there it is in a slightly oversize nutshell. For further information the following should be of interest:—

"A quantative study of combination tones" by Wever, Bray and Lawrence—Journal of Experimental Psychology (USA), 1940, 27. P217-226.

"Distortion in the ear as shown by the electrical responses of the "cochlea" by Wever and Bray Journal of the Acoustical Society of America, 1938. 9, P227-233.

"The interference of tones in the cochlea" by Wever, Bray and Lawrence—Journal of the Acoustical Society of America 1940, 12, P268-280.

"The auditory masking of one pure tone by another and its possible relation to the dynamics of the inner ear" by Wegel and Lane —Physical Review (USA) 1924, 23, P266-285.

J. F. McDermott.

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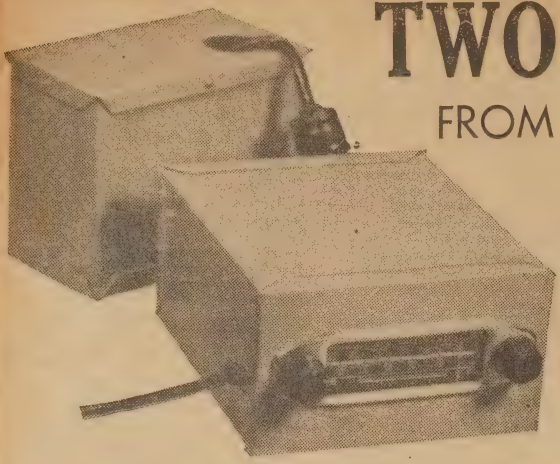

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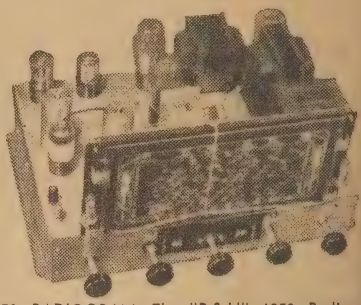

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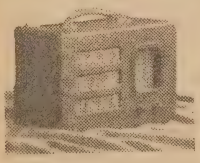

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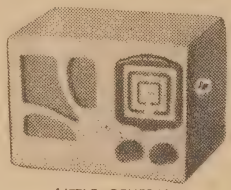
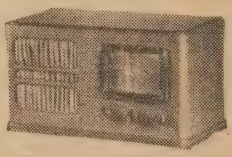


LITTLE GENERAL,



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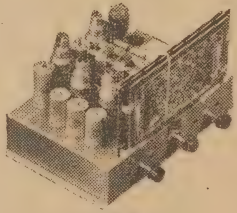

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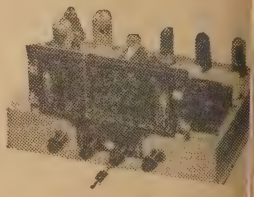

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uite small and definitely related to requency. It is an education to pend a few minutes listening to the imultaneous output of two sine-vave oscillators.

Set both to produce equal acoustic utput, one on say 400 cps and the ther a fraction higher or lower in requency. At normal room volume he beat will be most marked, be-oming almost vicious to listen to s the output from both is stepped p. Try reducing the output and the eat is found to persist until the ones are merely a whisper.

In other words, the non-linearity f the aural system as a whole—not ust the physically accessible parts —must be apparent at an extremely ow sound level and particularly at ow frequencies.

THOSE OTHER BEATS

Now what about the other kind of eats—the ones which occur between ones which approximate certain nusical intervals? Taking the implest case, why should we hear a eat between two tones which form n approximate octave?

By normal calculation, the only ombination tones formed by a pure 02-cycle note and one at 400 cps ould occur at 602 and 198 cps. Yet ar and away the most obvious effect s a low period beat at just a few ycles per second. What's gone wrong ll of a sudden? Are we up against he old bogy of "theory v. practice." leaven forbid!

I would suggest that the low requency beat is not the result at all f interaction between the funda-nentals. Rather is it the result of nteraction between the 400-cycle ote and a harmonic at 404 cps (i.e. x 202). Beating together, the two roduce a stimulus at 4 cps.

The remarks are entirely con-istent with Mr. McDermott's ormula relating to an approximate nusical fifth. To be sure, the formula oes not refer to harmonics by name ut the result is the same.

According to our correspondent:

eating rate equals 2 x 302 - 3 x 200
equals 604 - 600
equals 4 beats/sec.

Putting it the other way, the econd harmonic of 302 cps (at 604 ps) beats with the third harmonic f 200 cps (600 cps) to produce a eat at the difference frequency. hus 604 minus 600 equals 4 cps.

HARMONICS?

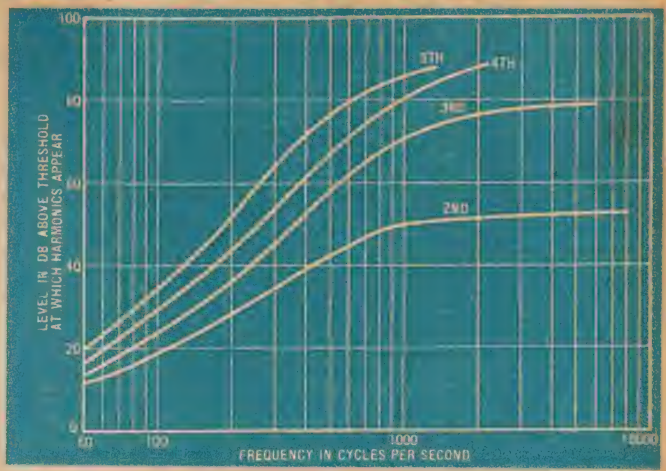
And where do the harmonics arise? he answer cannot simply be "from e sound source" because beats can e heard between apparently pure nes. The only satisfactory answer that the harmonics are produced ithin the aural system, and you will ote, at a level that may be very w indeed.

Any harmonics present in the iginal sound will modify the result it they represent only a second-der effect.

I can well imagine a retort to all his . . . "I say, old chap, that's a k grim, what! Mean to say I've ver heard a jolly old orchestra thout distortion? Bit thick isn't it?"

Well, Colonel, I'm afraid it is. Be-e we can budge from the asser-n, you have to explain some other chanism to account for beats be-een approximate musical intervals.

HARMONICS FROM AVERAGE EAR



A well known set of curves showing harmonic generator in the ear (Wegel and Lane). But does it tell the full story?

Of course, there is one shaky hypothesis which might be advanced, depending on a theory of natural harmony. It might be contended that, when listening to a single note, we psychologically wish to hear other notes which are consonant. A foreign note slightly off pitch from the one we wish to hear produces a beating effect. That theory is akin to pi, or 22 over 7. It won't go.

Personally, I'd much rather stick to the idea that we don't just imagine the extra tones but actually hear them by harmonic generation.

Another objection to the psychological approach is that our reaction to melody, harmony and chording is largely a matter of education. It is difficult for the conventional ear to appreciate Eastern music on the one hand, or modern European music on the other but who can say that it isn't pleasant listening for somebody?

PROBABLE REASONS

Of course, there may be partly physical reasons why we are ready to classify chords as consonant or dissonant.

A simple octave relationship C-C is easily analysed by the aural senses because the harmonics coincide and the structure of the sound is little more complicated than that of a single note.

Add G and, neglecting the approximations of the tempered scale, several of the harmonics coincide with harmonics already present from the C notes.

The same is true in part when the note E is added, many of its harmonics coinciding with those already present. Similar remarks can be made about other simple consonant chords.

As the complexity of the chord is increased, it becomes more difficult of analysis and the listener appeal becomes more selective. Ultimately it may become so rich in harmonics, combination tones and beats (the acoustic terminology) that it is rejected by the senses as unintelligible, unpleasant and dissonant.

If I can borrow an analogy from the editor, sound patterns can be likened to a table covered with colored marbles. They can be arranged in a pattern so simple that any one can see it at a glance. They can then be re-arranged in progressively more complex patterns until, as the process continues, the design becomes apparent only to a select few. To the others, the pattern will revert to just a lot of marbles on a table—chaotic and meaningless.

IN CONCLUSION

A great deal more could be said along this line but I will leave it for someone else to take up. It's been an interesting ramble to me anyway. I only hope that the validity of the original remarks has been proven en route—namely that combination tones, simple beats and interval beats are all basically the same and dependent on the distortion inherent in the aural system.

Come to think of it, music might be a lot less intriguing without the said distortion!

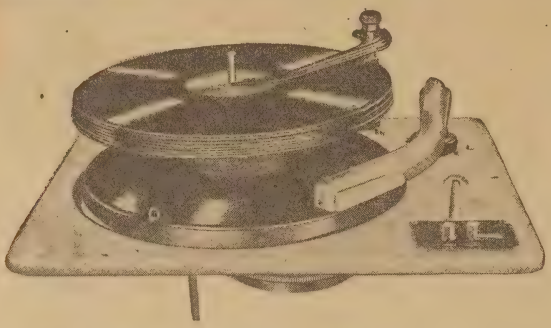
As for the "interference" and "masking" referred to by Mr. McDermott, I think they both spring from the same basic property of the aural sense. I have often heard it referred to by radio engineers as the ear's "AVC effect."

Indeed, there appears to be a close parallel between the operation of the AVC circuit in a receiver and the accommodation of the aural sense to sounds of differing intensity. Once again, it appears to vary widely between one person and another.

If you want a rather shattering demonstration of this "AVC effect," listen to the beat of two loud tones against a background hum of machinery. The background will rise

(Continued on Page 83)

two of the best . . .



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The secret of this split-second timing is said to lie in the use of four extremely stable quartz crystals that vibrate in temperature-controlled compartments at a frequency of 100,000 cycles a second. The crystals, in turn, control the operation of an electric alternating current to a precision of one-part in a billion. This current drives the motors of the clock element.

The device, believed to be the most precise in existence, is being used as the yardstick for precision time-keeping and other measurements throughout the Bell System's telephone, broadcasting and television service, and overseas, ship-to-shore and mobile radio telephone nets. The "time" from this device also is relayed to the Edison electric power generating stations and in turn regulates thousands of electric clocks.

Moreover, it is being used as a "very precise" reckoning of world time by constant comparisons made with the astronomical observations of the United States Naval Observatory and the National Bureau of Standards.

The apparatus at Murray Hill contains some 600 vacuum tubes and more than 25,000 soldered wire connections to link the whole together. It represents the culmination of five years of research and development under the direction of Bell laboratories engineers J. G. Ferguson, W. . Means and E. P. Felch. G. N. Packard is in charge of operating the device.

To make sure that a disruption of electric power would not stop the clock, operating power is derived from a large bank of storage batteries, charged by local power sources. A steam turbine generating unit is provided for charging when all other power fails.

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Substances to provide various odors are added to a harmless gas and put in containers at the television receivers. The light signals sent from the broadcast station will be of different frequencies, each frequency attuned to release the gas and odor from a particular container. The pressure of the gas will disperse the scent through the room.

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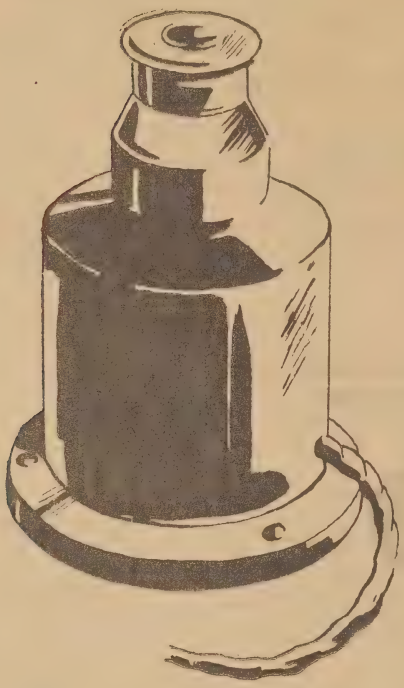

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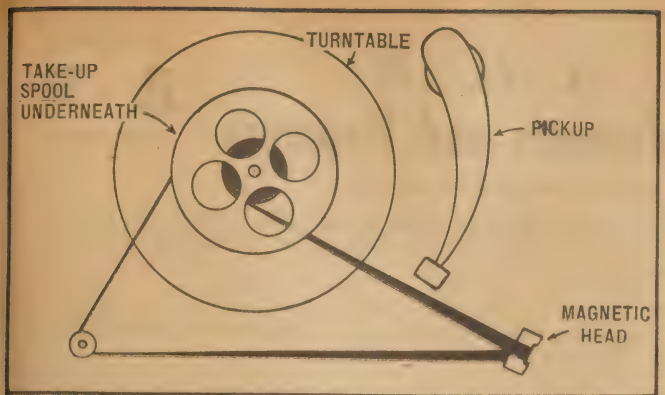


Figure 1: An elementary type of tape mechanism which operates in conjunction with a standard phonograph turntable.

Magnetic Recording

DRIVE SYSTEMS FOR MAGNETIC RECORDERS

The first problem which faces the prospective constructor of a magnetic recorder is that of devising a suitable system for driving and handling the medium, whether it be tape or wire. This article outlines the major problems and requirements which must be met for the unit to be at all successful.

THE drive system for a magnetic recorder may fall under one of three general headings—variable, pseudo-constant and constant-speed, the adjective describing in each case the actual travel of the medium.

The first two are commonly employed in wire recorders and are worthy of mention, if only by way of contrast.

The variable-speed system stems from the practice, on some machines, of winding the wire from one small spool to a similar spool, the latter being driven at a constant rotational speed. As the amount of wire on the take-up spool increases, so does its effective diameter, with the result that the speed of the wire past the scanning head gradually builds up.

WIRE SYSTEMS

This does not lead to any special difficulty for simple recording, provided that the wire is always played back as a whole and on the same pass of machine. If the wire is heavily edited, however, and a section from one end transferred to near the other end, the pitch and tempo of the recording is affected in much the same way as by playing a gramophone record too fast or too slowly.

In the pseudo-constant system the wire is run from the normal storage spool on to a large take-up drum driven at a constant speed. In this case, the incremental change in diameter is much smaller and the speed of the wire past the scanning head is more nearly constant. At the end of playing, the wire must, however, be run back on to the small drum for storage.

It follows that a recording made on a pseudo-constant system should be played back on a similar class of machine. Playback on a variable-speed machine produces a gradual change in the pitch and tempo of the recording throughout its length, which may or may not be serious, according to the nature of the recorded programme.

With magnetic tape, the standard practice is to feed it past the scanning heads at a constant speed, which has now become standardised at 30, 15, 7½ and 3¾ inches per second.

The 30-inch standard is used only where quality-at-any-price is the governing factor. The 15-inch standard is commonly used in the more elaborate wide-range studio set-ups, while 7½inch serves for all medium fidelity applications. This latter standard is the one of most interest to home recording enthusiasts.

At present, the 3¾inch standard is used only for speech or low quality recording.

REQUIREMENTS FOR TAPE

A constant speed drive involves passing the tape around a motor-driven capstan having a circumference speed equal to the rate of travel required for the tape. The supply spool is lightly braked and the take-up driven through a slipping-clutch system, as is common practice in movie projectors.

The constant speed system is not easily applied to wire because the coefficient of friction between a fine wire and the surface of the capstan is quite small. Tape, on the other hand, presents a large surface area which can be gripped with comparative ease between the surface of a metal capstan and a free-running pressure roller.

At first glance, driving the tape might appear to be no more of a problem than driving a phonograph disc at 78 rpm, but this is an important difference. A phonograph record and turntable have appreciable mass and inertia which tend to smooth out, by flywheel action, small irregularities in the drive.

Tape, however, like motion picture film, has very little inherent mass and the capstan drive system must of itself impart to the tape an absolutely constant speed of travel.

This requires, in turn, accurate balance and grinding of all moving parts, and the provision of an adequate amount of "flywheel effect" in the drive to the capstan.

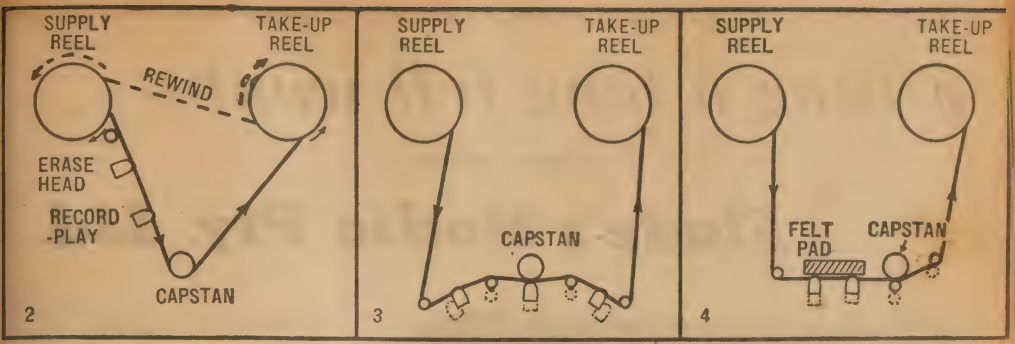
The initial requirement is, of course, to drive the tape at the required nominal speed, which is likely to be 7½ inches per second for normal requirements. The relevant calculations are simple enough, involving the speed of the drive motor, the ratio of drive to the capstan spindle and the dimension of the capstan surface which actually carries the tape.

DRIVE MOTOR

In the normal way, a motor would be used capable of operating at synchronous speed. With an appropriate drive ratio such as a motor can be relied upon to maintain at least the correct nominal tape speed. It is still necessary, however, to take precautions against short-term speed variations, which produce effects known commonly as "wow" and "flutter."

The "wow" effect is a slow periodic variation in pitch, of the type which occurs with a badly governed phonomotor. It is particularly objectionable with music and is readily noticed on sustained notes.

In a tape machine likely causes of "wow" are hunting effects in the motor or synch. slippage, the tendency increasing if the motor is unevenly or heavily loaded. Variable loading can be produced by frictional losses, particularly in the take-up mechanism. Uneven take-up can also "jag" and stretch the tape, while similar effects can be produced if



Figures 2, 3 and 4, illustrating possible arrangements for single track, twin track and "flip-flop" twin track systems

he tape drags against the side of an neven reel.

"Flutter" is a more rapid speed ariation which tends to impart a oughness or harshness to musical ones.

The most prolific source of flutter s vibration and unevenness in the apstan or capstan drive system, so hat the tape travel is modulated in ympathy with the rotational speed f a particular shaft. Only by ery careful balancing and machin- ng can this trouble be eliminated.

Before discussing further the "ways nd means" of tape drive, it may e wise to examine first the basic equirements, as they effect the ome recordist.

It can be taken as a flat rule hat the only fully satisfactory echanism is one which allows for apid threading and rapid handling f the tape, so that there is a inimum of delay between record nd playback or between individual layings.

A machine may be able to record ntinuously for a half-hour, but, nless facilities exist for rapidly inding back the tape, another half- our may need to elapse before the cording can be heard. Delays this nature are intolerable, even etween shorter items, and will lead timately to the device being dis- rded as annoying and impract- al.

Intending constructors should erefore be warned against expect- g too much from schemes which ve only simplicity to recommend em.

EWIND SYSTEMS

At the very least a fast rewind stem should be included, even if is hand-operated. High-speed otor rewind is to be preferred, of urse, commercial machines com- only requiring about one minute rewind a half-hour spool.

It is usually possible to use the wind facility for fast forward nd, simply by loading the spools the machine back-to-front. When e required portion of the reel is ached, the spools are interchanged d loaded normally for play.

Ideally, a recorder should have ovision also for fast forward s ttle, since it minimises handling the spools. With fast forward and t rewind facilities, it is possible select and play an item anywhere a full reel and rewind the tape mediately afterwards.

The point is often made that twin- k tapes obviate the need for ch rewinding, since playing the second track through to its conclusion automatically runs the reel back to its "start" position. The contention is only valid, however, where the recording is long enough substantially to fill a tape and where it is intended to play the recording right through.

For domestic purposes, this is the exception rather than the rule, because the home recordist is more frequently interested in playing back a variety of short items or in playing excerpts from longer works. Complete tape handling facilities are required for this, the twin-track feature being most important to the individual merely as a means of conserving tape.

However, returning to the original discussion, careful thought must be given to the design of a machine which offers the fast-winding feature in both directions. If the tape is moving only slowly, it is usually possible to reverse its direction abruptly without complication.

TAPE BREAKAGES

However, if the tape is being wound at high speed in one direction and the drive is suddenly reversed to full speed in the other direction, the tape can very easily be snapped. This is especially likely with large, heavily-loaded reels, which acquire considerable inertia.

To guard against an inadvertent control error, it is therefore highly desirable for the drive switch to pass through intermediate positions and a braking position which will automatically stop the reels before reversing the drive.

Some commercial machines use trip switches operated by the tape itself to prevent abrupt reversal. Others employ an electronic or mechanical interlock to give the same result. Still another scheme is a differential clutch arrangement between the free-running and the take-up spool, so arranged that the tape is always kept taut and the driving force on either spool is transmitted immediately to the other. This prevents over-run and the subsequent abrupt takeup.

An important condition to all this is that the tape must be held firmly against the magnetic gap, at precisely the right height, and at an exact right-angle thereto.

Up-and-down wander of the tape may cause a variation in noise and output level, with possible cross-talk between adjacent tracks in an extreme case. If the gap is not maintained at an exact right-angle to the tape, severe high note loss will occur. Inaccurate alignment can bring to nought the most meticulous care with gap dimensions.

The translation of these basic mechanical requirements into practical reality has tested the ingenuity of commercial recording designers and not all their schemes have been above criticism.

However, knowing the basic requirements, the construction of a tape drive mechanism should still be within the capabilities of home constructors, with mechanical training and facilities. A major difficulty, at the moment, is that of design, since blueprints and plans for a complete fabrication are not commonly available—at least to our knowledge.

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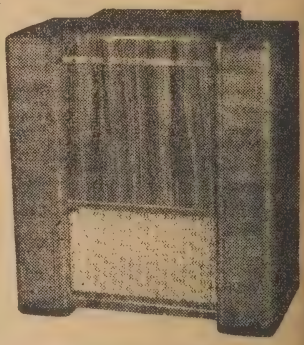

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few tools and the kitchen table, the home constructor must rely largely on ready-fabricated components, and these are only just beginning to appear on the local market. It is not yet clear how plentiful the supply of these components will be, to what degree they will be standardised, or how their price and performance will appeal.

"Radio and Hobbies" is watching the position carefully from the home constructor's point of view, and will describe home-made gear just as soon as we can evolve something, with the co-operation of the trade, which readers might reasonably duplicate.

MANUFACTURED UNITS

In the meantime, it is likely that the initial step in the trade will be the release of "tape decks," and one or two models have already been announced. A tape deck will be sold as a complete unit in much the same way as the conventional record player, and will normally include the tape drive mechanism, spooling and control facilities and whatever magnetic heads the manufacturer regards as optimum.

It will be up to the home constructor to provide the amplifier circuits for recording and playback, and to house the lot in a suitable cabinet. Though the suggestion can only be speculative, it would appear that the price of a good average tape deck will run out around the £40 mark.

Tape drive mechanisms fall roughly into two classes.

The first and simplest variety, and one which may prove very popular with home recording fans, is a tape deck which attaches to an ordinary phonograph turntable. Provided the turntable is well-regulated and smooth-running, it dispenses rather simply with the initial drive problem.

With a few brackets and pulleys and a little ingenuity, it is not unduly difficult to pull the tape smoothly across the face of a magnetic head. Considerable care is necessary, however, to ensure that the tape is held in accurate alignment with the gap and this demands, in turn, that the mechanism be accurate, no matter how simple it may appear.

TWIN TRACK MACHINES

In the most primitive system, the tape is simply fed from the supply reel, round the head and a pulley and on to a takeup reel, which is in contact with the turntable. This gives a variable speed drive with its attendant limitations of varying frequency response and non-suitability for editing. There may be no facilities either for rapid rewind.

A further objection is that the turntable cannot be used simultaneously, so that program cannot be transferred on the same machine from tape to disc or vice-versa.

More elaborate systems provide for constant tape speed and fast handrewind, which naturally adds to the value—and the cost—of the unit. By using the tape components on an elevated deck, the utility of the turntable can also be preserved.

It would appear, at this stage, that this general approach holds the greatest promise both for inexpensive tape decks and for units which can be home-constructed without elaborate mechanical facilities.

The preferred method is, of course, to construct the tape deck as a completely self-contained unit, with its own drive mechanism meeting the requirements already listed. The component parts can be arranged in a variety of ways, and the simplest approach, from the reader's point of view, is probably to describe two or three typical systems.

Figure 2 illustrates a likely layout for a single track tape deck, which is so arranged that the tape is pulled past the magnetic heads as it runs off the supply reel.

For rewind, the tape is slipped off the capstan and runs straight across the deck. It is highly desirable to disengage the tape during rewind, both to avoid wear on the tape and more especially on the surface of the magnetic heads.

The question arises immediately of how best to drive the various spindles. As already emphasised, the drive to the capstan must be absolutely smooth and constant. No drive is required on the supply spool for forward playing, but it must be driven at high speed in the reverse direction for rewind.

The take-up reel poses a special problem, because it requires a variable speed drive. When the spool is nearly empty, the rotational speed will be more than double that necessary speed for a full reel. The torque must at all times be sufficient to wind the tape fairly tightly, yet never enough to stretch or break the tape.

One popular arrangement is to use three separate motors to operate the spindles, the capstan motor being of the synchronous type, for obvious reasons. The rewind motor on the supply reel is geared to run at an appropriate speed and merely "free-wheels" backwards during forward playing. The switching is interlocked so that this motor can only be energised after the supply to the other motors has been cut off.

The take-up motor is found in various forms, the most elaborate being a special type whose torque varies inversely with speed, so that the linear pull on the tape is the same, irrespective of how much tape is on the take-up spool. Extremely careful design is necessary with such motors, some early commercial versions suffering badly from overheating.

More simply, ordinary light motors have been employed with limiting resistors to cut down the torque and to prevent overheating at slow operating speeds. A delicate balance of the constants is generally called for, the drive being arranged so that motor can run as close to nominal speed as possible with minimum takeup diameter. The torque under these conditions must be limited to a safe figure.

As the takeup diameter increases the motor will be slowed down and the linear torque on the tape will diminish, but it must not be to a degree which will lead to uneven winding.

From the financial viewpoint there is an obvious objection to using three motors and schemes have been evolved, some of them quite successful, for using a single motor or two at the most.

The vital point is always the capstan drive. It follows that a larger motor will be required for this purpose if it must simultaneously perform another function.

A satisfactory drive can be arranged off this motor for the take-up reel by means of a slipping clutch. The clutch can take various forms, but experience seems to indicate that dry graphite-lubricated surfaces are more reliable than "wet" clutches, especially under varying atmospheric conditions.

Some machines employ an ordinary spring belt of the type used in substandard movie projectors and this would appear to be an obvious choice for the home constructor.

Whether belt or clutch is used, the tension must be carefully adjusted to maintain sufficient, but not excessive, torque at all times. Maladjustment may lead to tape breakage on the one hand or to complete cessation of takeup when the reel becomes near-full.

The rewind mechanism poses a special problem, because the drive is in reverse and the spindle speed much higher than would normally be required for playing. Some de-

(Continued on Page 95)

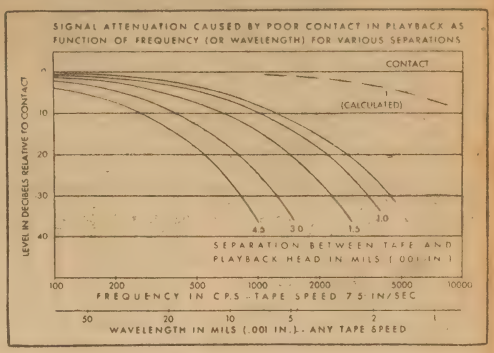
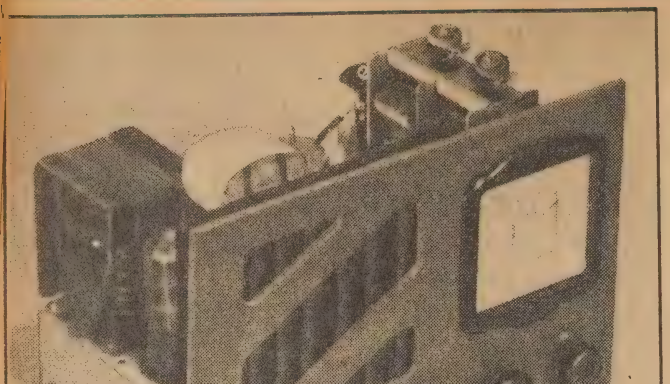


Figure 5: Showing the losses which can occur if the tape does not maintain intimate contact with the gap face.



The front view is not greatly different from last month's receiver.

LEARN WHILE YOU BUILD

This month your set "grows up." You can put aside the headphones and let the whole family listen. Yes, we are fitting a loudspeaker and, in the process, delving into the mysteries of resistance coupling, cathode bias, and power output. There's no doubt about the results either. They're really good!

by Philip Watson

THE set as it stands may be coaxed into giving some kind of results from a speaker—in fact we tried it ourselves and were agreeably surprised. However, it cannot be classed as a loudspeaker set in the true sense of the term.

It can be made into one by the simple addition of another stage, known as a "power output" stage, while leaving the front end of the set essentially the same as last month.

Reference to the circuit diagram will give you some idea of the changes involved. First there is a modification to the power supply, for the simple resistance type filter system we have used to date is not adequate for the amount of current we will need for the new valve. Instead, we have fitted a small filter choke having an inductance of 14 or 15 henries (the henry is the unit of inductance), but with only a few hundred ohms of DC resistance.

BETTER FILTER

As we mentioned in our discussion on power supplies (R & H June 1951), the choke provides better filtering under these circumstances than does the resistor, the later being satisfactory only when the current requirements are small. A resistor reduces the voltage available from the power supply (this was desirable for our smaller sets) but we now require the full voltage and current which the supply will give, amounting to about 225 volts at 50 mA.

The new valve is a 6V6-GT, which is one of the most popular of its type, being standard equipment in domestic receivers for several years. In many respects, the fitting of this new valve is similar to the fitting of a valve to our crystal set (Amplified crystal set, May 1951).

VOLTAGE AMPLIFIER

You will remember that we described the action of the valve in this set by explaining that the amplification characteristic caused a greater flow of signal current through the headphones than would have been the case without the valve. Now this is really an increase in power since an increase in current flow must also mean an increase in voltage across the phones.

Although the results were satisfactory in the case of headphones the 6AR7 is not really designed as a power output valve, but rather as a voltage amplifier. In this latter role its job is simply to increase the voltage of the incoming signal because the grid of the following valve is only sensitive to changes in voltage and requires no real power to drive it.

On the other hand the speaker does require power—a great deal more than the headphones—and the only way this can be provided is by means of a special valve designed to deliver power output. Such a valve is the 6V6, which is capable of delivering considerable power, about four watts, but which requires 12 volts or so of signal to drive fully.

OUTPUT VALVE

Where this voltage is not available from the actual detector circuit it is necessary to provide a voltage amplifier ahead of the power valve to raise the signal level to the required voltage. Up till now the 6AR7 has been working as combined detector and small power output stage, but from now on it will function as detector and voltage amplifier.

We now come to the problem of transfering these signals from the plate circuit of the 6AR7 to the grid circuit of the 6V6. You may remember that, in the Amplified Crystal Set, we replaced the headphones with a load resistor which was also connected between the grid and cathode of the valve.

Unfortunately this is not possible when the preceding stage is a valve, for, in addition to the signal voltage across the load resistor, there is also a steady DC voltage across it. If these were applied to the grid circuit of the following valve it would completely upset the operating conditions and some means must be found to transfer the signal voltages only.

DC BLOCKED

Figure 1 may help to explain how this is done. The resistor R1 is the plate load of the amplifier valve and as the current through it varies under the influence of the grid, the voltage across it (between A and B) will also vary. This variation is the signal we wish to apply between the

id and cathode of the power valve, d connection between point A and e grid is made by means of the upling condenser C.

The property of the condenser is ch that it offers a low impedance th to the signals, but blocks off e DC voltage—which is just the fect we require.

The connection from the other end the resistor, point B, to the thode is more round about and, for is reason, it is often ignored. How-er, it is none the less necessary and rth working out.

Point B is the HT supply point of e set and between here and chassis ll be the last filter condenser of e power supply. In addition to its tering action, it provides a low pedance path for any varying ltages so that, as far as these are ncerned, point B is connected to e chassis. But the cathode of the wer valve is also connected to assis, through a resistor it is true, t this is also by-passed by a large lue condenser, so that there is a w impedance path all the way from int B to the cathode.

Finally we must provide some eans of completing the grid-thode circuit of the power valve order that the necessary bias may applied between grid and cathode. rthermore we must ensure that s potential is restored after each cursion of the applied signal ltage. In fig 1, R2 performs this nction, and is known as the grid sistor.

ESISTANCE COUPLING

This arrangement is correctly de-ed as resistance-capacity coupling, t it is more usually referred to nply as resistance coupling. It is extremely popular system, since combines good quality results with nple circuitry, few components d low cost.

The plate load resistor in this set the .1 megohm volume control d the only other alteration to this rt of the circuit is the fitting of screen resistor of .5 megohm to mpensate for the increased HT ltage.

From the moving arm of the vol-ne control connection is made to e grid of the 6V6 through a .05

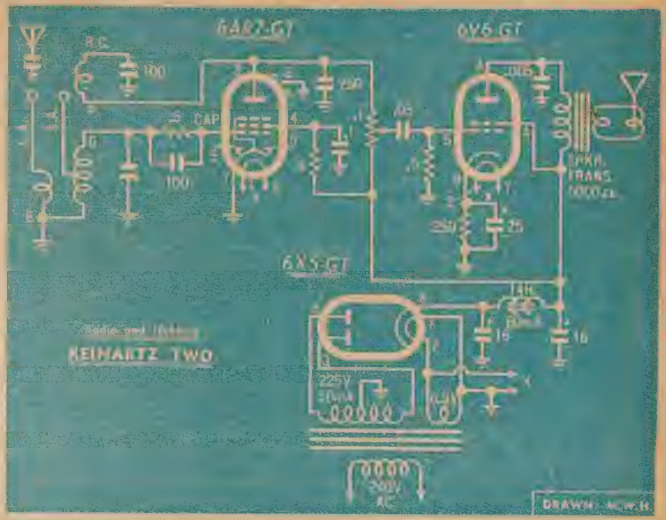
EXTRA PARTS

5" speaker. Permag. with 5000 ohm transformer.
14/60 choke or similar.
6V6 valve.
Octal socket.
.5 megohm resistors.
.05 mfd 600 V paper condenser.
.005 mfd mica condenser.
Scrap of aluminium for valve shield. wood or Canite for baffle.
Speaker silk, nut and bolts, solder lugs.

l condenser and the grid resistor the 6V6 is .5 megohm.

he position of the volume control omewhat unusual, normal prac-being to connect the control in grid circuit of the second valve er than in the plate circuit of first one. However, the value of rol which you have on hand is used the way we have shown

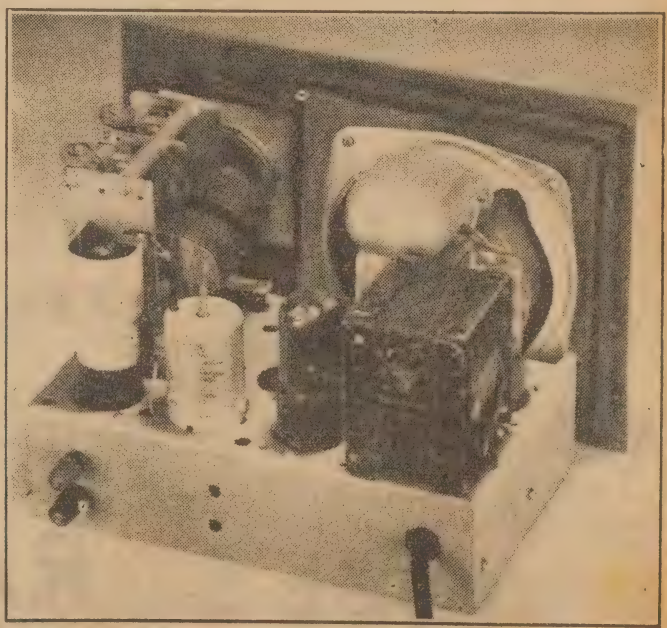
CIRCUIT OF THE 2-VALVE SET



Despite the circuit's simplicity it can give extremely loud signals from local stations, and is quite easy to get going.

The only other part of the circuit which remains unexplained is the bias network in the cathode of the 6V6, and now is as good a time as any to come to grips with it. Firstly what are the requirements of a bias system? Well, simply that a certain voltage be effective between the cathode and grid, with the latter being negative.

The exact value will depend on the type of valve and the operating



The 6AR7-GT mounts behind the gong with a small metal shield around the grid cap and condenser. The 6V6-GT is beside the transformer, and the 6X5-GT immediately behind it

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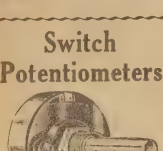

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1K7G. 2 volt battery du diode Penthode . . . . .
6H6. 6.3 volt. Metal du diode . . . . . .
6SH7. 6.3 volt. Metal Penthode . . . . . .
7193. 6.3 volt Special U triode . . . . . .
VR137. RL16. 6.3 volt U triode . . . . . .
VR136. RL7. 6.3 volt U Penthode . . . . . .

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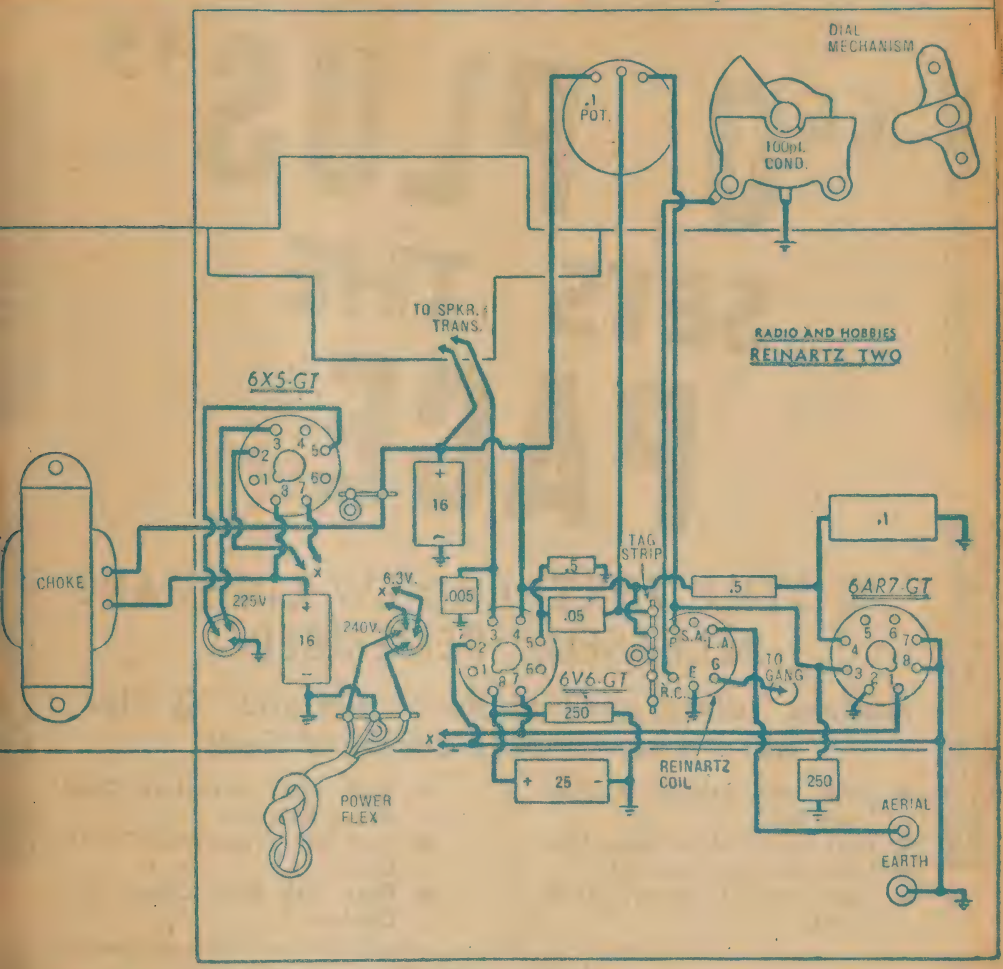
WIRING DIAGRAM OF THE "REINARTZ TWO" SET

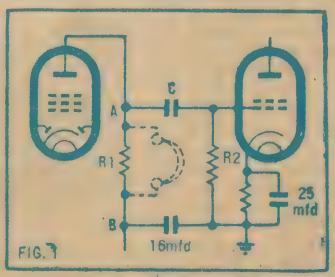


This wiring diagram has been specially prepared to assist beginners in placing the parts under the chassis.

nditions and, for our 6V6, we re-
ire a nominal 12.5v. It would be
ssible to obtain this from a battery
t it is more convenient if this
n be avoided.

For a start, consider the 250 ohm
istor only. Being in the cathode
cuit it will carry all the current
wing through the valve, and will
ve a voltage developed across it
pending for its value on the value
the resistor and the current flow
we know the current flow
we should) we can calculate a
istor value which will produce the
uired grid bias, which works out
250 ohms in this case.

The polarity of this voltage is
gative at the chassis end, which is
what we require, since the grid
connected to the chassis through
.5 megohm grid resistor. A point
ich puzzles a lot of beginners is
w the full voltage across the bias resistor is still effective at the grid, since it is applied through the high value of the grid resistor.



This diagram illustrates the principle of resistance coupling.

The explanation to this is simply that there is no flow of current through the grid resistor, so there is no voltage developed across it, and the full value of bias is applied to the grid.

Well that explains the action of the resistor, but what of the condenser? Our discussion so far has assumed that the current flow through the valve is perfectly steady, but this will only be the case so long as there are no signals applied to the grid. As soon as signals are applied the current will change and, in so doing, will change the bias voltage. Unfortunately it will change it in the opposite direction to the incoming signal, tending to neutralise the latter and considerably reduce the sensitivity.

Or at least this is what would

(Continued on Page 57)

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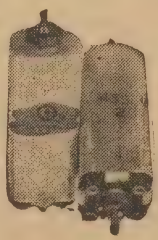

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A COURSE IN TELEVISION

PART 27—RF POWER SUPPLIES

RF power supplies are used less extensively in television receivers than either of the other types—60 cycle or flyback systems. They are sufficiently important, however, to warrant mention in the series, particularly as they may be employed freely in high quality oscillographs for television testing.

THE basic principle of an RF power supply is quite simple. A conventional power valve such as the V6 or 807 is set up in an ordinary class C circuit and made to oscillate in the region of 100-200 Kc.

Adjacent to the oscillator tank a secondary winding is mounted having a large number of turns and arranged to be self-resonant at the frequency of oscillation. A very high peak RF voltage is generated across this secondary winding and this voltage is duly rectified and filtered for application to the picture tube circuits.

RF power supplies have a number of good features, one of the most important being the ease of filtering.

FREQUENT CHARGES

If the oscillator is operating at say 200 Kc, the filter condensers will receive 4000 charges for every charge which would flow in a 50-cycle system. Using the same filter components, the amount of ripple from the high frequency supply would be reduced to microscopic proportions.

In practice, it becomes possible to reduce the value of the filter condensers to a small fraction of that suggested last month for a 50-cycle supply and a figure of 500 pf. is fairly commonplace.

This means an immediate saving in the cost and bulk of the filter and there is the additional advantage that the amount of energy stored in the filter is not likely to approach the danger mark in the event of accidental shock.

A further point in this regard is that contact with the system, particularly on the RF side, normally has the effect of detuning the secondary and thereby reducing immediately the peak voltages present in the circuit.

POWER TRANSFORMER

A further and obvious advantage of an RF power supply is that it obviates the usual bulky — and costly — high voltage 50-cycle transformer. The advantage is not of great consequence at moderate EHT voltages — up to about 2000 — but insulation and winding problems tend to multiply rather steeply beyond that. As a result, it may be simpler and cheaper in the long run to use an RF supply, even though it means providing a complete high frequency oscillator circuit.

Figure 1 shows a simple RF power supply of the type which might be employed in a small receiver or an oscillograph. It uses a 6V6-GT os-

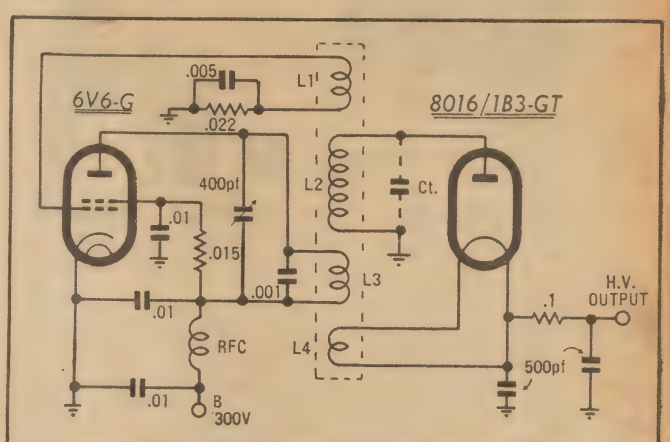

Figure 1. Circuit diagram of a typical RF power supply. Oscillator plate circuit and high voltage winding are resonated to same frequency for maximum EHT output.

cillator valve under normal class C oscillator conditions.

The frequency of oscillation is determined primarily by the tuned plate circuit, involving L3 and two parallel condensers. L1 is a feedback winding connected, in appropriate phase, to the grid. This forms the basic RF oscillator circuit.

L2 is the high voltage winding which must be wound with a large number of turns to give a suitable step-up ratio in relation to L3. To obtain the maximum energy transfer,

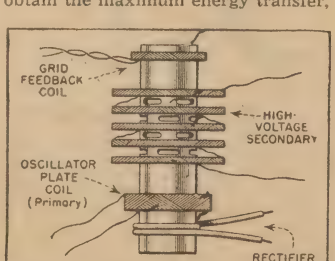

Figure 2. Illustrating the construction of a typical RF supply transformer.

L2 is normally designed to be self-resonant within the tuning range of the basic oscillator.

This latter consideration is actually one of the factors which govern the selection of an operating frequency. While a high frequency is a guarantee of improved filtering, it becomes increasingly difficult to achieve a sufficiently high resonance in the secondary winding, particularly if it must be wound with sufficient turns to produce a very high voltage.

It will be noted that the rectifier is a half wave type and that its filament is supplied from yet another winding on the RF transformer — in this case L4.

RECTIFIER FILAMENT

With some circuit arrangements, it is desirable to have the filament of the rectifier as the positive EHT point, which requires that it be supplied from a suitably insulated source. Rather than provide this winding on a 50-cycle transformer, it is often easier to add a small winding to the RF transformer and draw the filament power from the oscillator.

Naturally, it is necessary to select a rectifier having a modest heater rating and this factor is taken into account in the design of rectifiers for this class of service.

Figure 2 suggests the construction of a typical RF transformer as used in the circuit of figure 1.

The coils are wound on a thin walled tube of impregnated bakelite or some other material exhibiting low power factor and leakage. The grid and plate windings occupy the same respective positions as in the circuit diagram.

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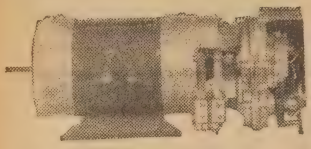

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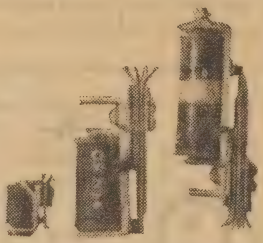

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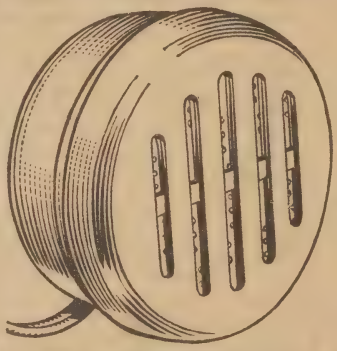

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In between the two is placed the igh voltage secondary, which is ormally wound in several sections. his ensures fairly low distributed apacitance and reduces the chance f voltage breakdown, since only ortion of the total peak voltage ppears across each individual ection. The windings L1, L2 and L3 ould normally use litz wire. L4 omprising probably two turns of eavy gauge.

Efficient power transfer is ensured rom the oscillator circuit by keepng the "Q" of the high voltage secndary as high as practicable and aking it self resonant. Slots in the ormer between the respective secons reduce losses through the ormer and also allow free movement of air through the windings r cooling purposes.

The overall efficiency of a power pply of this nature is quoted at etween 25 and 45 percent, although is is not a very important conderation in ordinary mains-operted equipment.

ARGER OSCILLATOR

Where extremely high voltages are equired, as for the operation of me large tubes or projection type quipment, a single 6V6 oscillator ay not be able to supply easily e requisite secondary power. In is case valves like the 807 or the ewer 6BG6 may be employed.

Another special case arises with eceivers operating with restricted T supplies, as might be the case "transformerless" circuits. The ractice here is to use valves like e 25L6 which are expressly deigned to deliver substantial power ith a comparatively low anode oltage. Two such tubes are comonly used in parallel where increased demands are to be made on e EHT circuit.

Yet another variation, which has een used in some American reeivers, eliminates the grid winding 1 and substitutes for it a simple apacitive feedback loop. The basic ircuit is shown in figure 3. Here the scillator plate tank is maintained s its usual form, likewise the recfier filament winding and the high oltage secondary winding. Feedack is provided by a very small apacitance connected between the ctive end of the high voltage secndary and the oscillator grid.

EEDBACK CAPACITOR

Since the RF voltage across the econdary is very high, only a very mall capacitance is necessary to aintain oscillation and one scheme, hich has been used, is to terminate e grid lead with a tinfoil band or ven a light spring which simply asses around the envelope of the igh voltage rectifier. The position f the spring or band in relation to e rectifier plate governs the degree f oscillation and must be adjusted s the event of the rectifier being eplaced.

An interesting point arises in adsting an RF power supply in that e rectifier filament voltage canot be measured by ordinary means ecause it is fed from a high freuency source.

The usual procedure is therefore set up a similar rectifier with a nown battery or a 50-cycle filament pply and to match the temperaure of the filaments by visual inpection.

If the temperature of the filament operating from RF is seen to be lower than the one operating from the known and correct voltage, it is necessary to slide the heater pick-up coil closer to the oscillator plate tank. The reverse procedure is adopted if the filament is operating at too high a temperature.

As might be expected, one of the chief difficulties which can be experienced with an RF power supply is that of radiation and harmonic interference with other circuits in the receiver. Even though the fundamental frequency may be in the vicinity of 200 Kc, the harmonics from a high-powered and intermittently loaded oscillator may extend over a large portion of the spectrum.

It is normal, therefore, to enclose an RF power supply in a heavy shield box to filter thoroughly all supply leads. Fortunately, this does not involve a great real of extra effort, because it is normal practice anyway to provide some form of cage around the EHT section of the receiver for safety reasons.

INTERFERENCE

Unless complete isolation is achieved, however, the harmonics from the oscillator can very easily cause trouble in the picture image. The most disconcerting effect occurrs when a harmonic happens to produce a visual beat with the line scan frequency. By modulating the intensity at a rate comparable with the line scan, bars of light and shadow can result which move slowly across the picture.

The difficulty of achieving complete isolation has led to the development of a scheme which obviates the possibility of visual RF interference. This is known as the "triggered" RF supply and the circuitry is so arranged that the RF oscillator functions only during the flyback intervals. Since the screen is blacked out, it matters little whether or not some RF radiation occurs.

There are many possible variations of the pulsed RF idea and it is scarcely necessary at this stage to examine them in detail. Some of the schemes lead logically to the flyback type of supply which will be described next month.

In one typical system a low power triode is arranged in an oscillatory circuit but normally kept inoperative by a positive voltage on the cathode. This is derived from a bleeder across the normal HT supply. Negative pulses from the horizontal sweep circuit are applied to the cathode to cancel the stan ing bias, thus allowing the valve oscillate during the brief flyba period. The impulse from the fo ward horizontal trace abruptly cu off the oscillation immediately afte wards.

However, the oscillatory puls are applied to the grid of a pow amplifier tube and stepped up to high peak voltage by an RF au transformer in the plate circuit. Th voltage is duly applied to a rectifie whose filament is also fed from winding on the auto transforme The rectified output is filtered in th normal way and fed to the pictu tube.

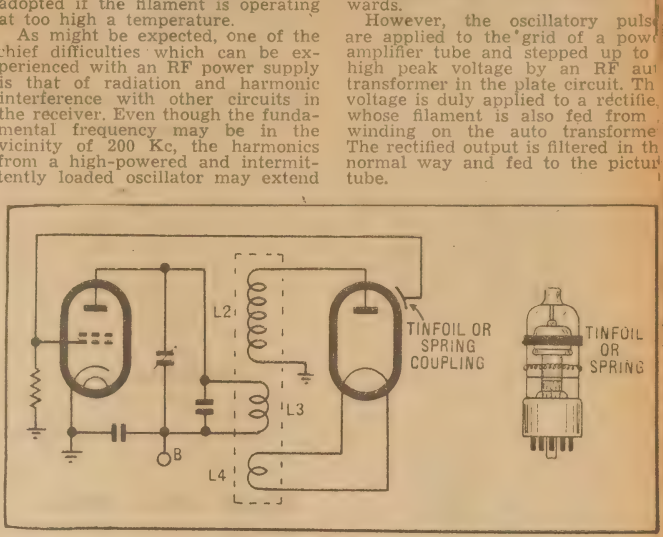

Figure 3. A somewhat different arrangement for an RF power supply using capacitive feedback to the oscillator grid circuit.

This latter scheme lends itself rather well to a system of voltage regulation which tends to maintain the gun voltage at a fairly constant figure. Chief advantage of voltage regulation is that it allows the average picture brilliance to vary according to the subject matter, thereby retaining full dramatic contrast in the program.

In cases where the picture tube current varies widely with intensity, and where the bleed on the EHT supply is not enough to ensure good regulation, much contrast can otherwise be lost from one scene to the next. Focus may also be affected.

The system of voltage regulation referred to uses another triode so arranged that it controls the screen voltage and therefore the pulsed output of the power amplifier tube. Increased drain by the picture tube, resulting in lowered EHT voltage, increases the output of the amplifier, delivers more input to the rectifier and therefore offsets the loss in EHT voltage.

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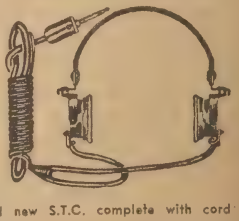

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TUNING CIRCUITS FOR RECEIVERS

Here is an article which will suit those who like their theory mixed with a few formulas and vectors. Prepared by the Engineering Dept. of the Aerovox Corporation, it analyses the operation and characteristics of parallel and series-tuned circuits.

TUNING, as performed in radio reception, consists essentially in setting certain circuits to admit signal voltages of one frequency while excluding those of all other frequencies. Selectivity is a measure of the extent to which this action is achieved.

A circuit is said to be selective when it enables the complete rejection of unwanted frequencies, even those which lie quite close to the desired signal. All receiver-tuned circuits should contribute to selectivity.

The important tuned circuits of a receiver are identical with the basic arrangement shown in Figure 1 (consisting of a capacitor connected in

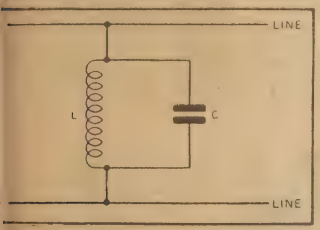

Figure 1: The basic parallel tuned circuit. In a conventional receiver, the lower "line" is usually an earth return, the upper end connecting to a plate or grid.

parallel with an inductance), or are elaborations of the same arrangement.

In order that the circuit may be adjusted, the property of one of its elements is made variable. Though entirely possible, it would be difficult for manipulation to have both variable.

The majority of systems, mainly for mechanical reasons, employ a variable condenser, rather than a variable inductor.

The tuning system of a receiver may employ either series tuned or parallel tuned circuits. The characteristics of the two are essentially the same, except that the series tuned circuit depends on a line current INCREASE for its operation, while the parallel tuned circuit depends upon line current DECREASE.

Therefore the selectivity of the series tuned circuit depends primarily on a low line resistance, while the selectivity of a parallel tuned circuit depends primarily on a source of high series resistance.

In the coupling transformer of an RF or IF stage, the grid circuit is really a series-tuned circuit, for the voltage is induced in the coil and can therefore be considered as acting in series with the coil and the condenser.

The plate circuit of an IF transformer is, however, a parallel tuned circuit in series with the plate impedance of the tube. Since this plate impedance is fairly high, the parallel circuit gives high voltage gain and selectivity.

The property of parallel resonance, as in the circuit of Figure 1, is basic to the operation of the tuned circuit, and an understanding of the principles is essential to a full comprehension of tuned circuit operation and design.

An alternating current views the parallel resonant circuit of Figure 1 as an inductive reactance in shunt with a capacitive reactance.

In flowing through the combination, the current will encounter separate impeding effects in the two legs, the two reactances acting upon it by different amounts, depending upon the frequency of the current alternations and the individual values of the coil and condenser.

At some one critical frequency, for any given values of inductance and capacitance, the inductive reactance and capacitive reactance will be equal.

Beause of the nature of the two kinds of reactance, the impeding action will be almost entirely due

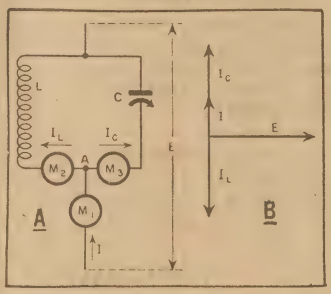

Figure 2: Illustrating the current and vector relationships in a parallel tuned circuit. The current in the line and in each branch varies with the setting of "C".

to the capacitive element at frequencies below this critical frequency and to the inductive element at frequencies higher.

At the critical frequency of RESONANCE, the two reactances, being equal and of opposite algebraic sign, neutralise each other, leaving the coil resistance (which is generally negligible in comparison with the coil reactance) as the sole circuit property remaining to impede the passage of current within the circuit itself.

Consider three suitable AC ammeters, M1, M2 and M3, connected in the parallel resonant circuit in the manner illustrated in Figure 2. When an alternating current, I, is caused to flow into the circuit by action of an impressed emf, its intensity will be indicated by the meter M1.

This current, termed the line current, will divide at the junction point A, and a portion (Ic, the condenser current) flowing through the capacitive leg of the circuit, will actuate M3. The other component (IL, the coil current) flowing through the inductive leg, will actuate M2.

The readings of M2 and M3 will normally be unequal, and that of M1 may be LESS than either of the former.

If the capacitance of the condenser C is then varied throughout its range Ic and IL will gradually tend to become equal, while, at the same time the line current (I) will be growing steadily smaller.

Assuming that the capacitance range of C is appropriate, there will be one setting of the condenser at which C and L will have the proper relation to render the circuit resonant at the frequency of the applied voltage.

"I" will fall to a very low value approaching zero, at resonance, while the large magnitude and near equality of Ic and IL at that point indicate that the reactive properties of the circuit have very nearly disappeared.

Because of the high current in the circuit the voltage developed across LC will be at its peak.

Beyond resonance, Ic and IL will again became unequal as the capacitance of the condenser is varied further.

Thus it may be seen that the proper adjustment of L and C to resonance for any frequency will result in the appearance of a maximum voltage (the resonant voltage) across the combination and minimum current (line current) in the external circuit.

When the circuit is connected to a voltage-operated device, such as to the grid-cathode input of a vacuum tube, voltages of desired frequencies may be selected and applied to the device by resonating the circuit. This is the basic function of the receiver tuned circuit.

The resonant frequency (f) may be determined from the equation:

$$(1) \qquad f = \frac{1}{2\pi\sqrt{LC}}$$

From which:

$$(2) \qquad L = \frac{1}{4\pi^2 f^2 C}$$

And

$$(3) \qquad C = \frac{1}{4\pi^2 f^2 L}$$

f is in cycles per second,
C in farads, and L in henries.

f in each case is taken to be the resonant frequency.

The above equations hold for both series and parallel circuits.

In the case of pure capacitance in parallel with pure inductance the simple vector relations of Figure 2B would apply. Here Ic is leading the applied voltage, E by 90 degrees. "I" (the line current) leads E by 90 degrees when Ic is greater than IL and legs E by 90 degrees when IL is

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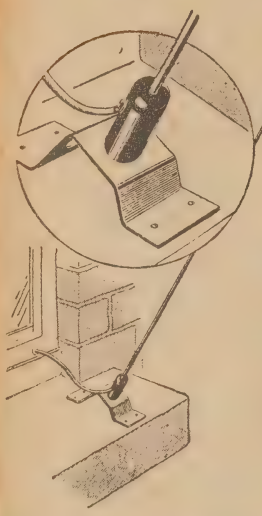

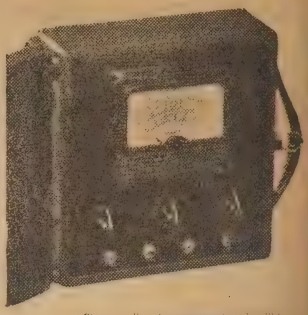

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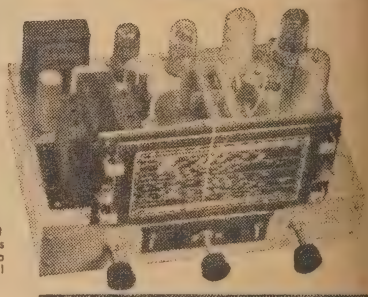

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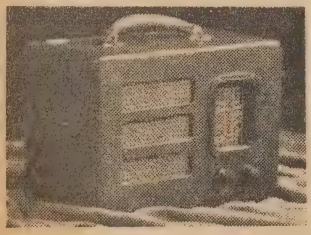

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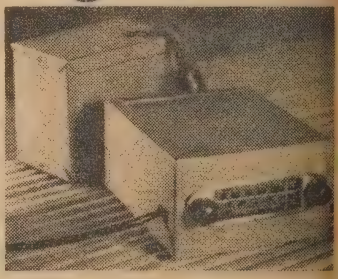

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greater than Ic. When Ic equals IL (parallel resonance) I is zero.

Inductive reactance is equal to the expression omega L and capacitive reactance equals 1/omega C.

In actual practice all coils possess some RF resistance, which appears as a resistance in series with L (see Figure 3) and this gives distinctly different expressions for Ic and IL, as follows:

$$(4)\quad I_c = -X_c E = -\omega C E = -2\pi f C E,$$

$$(5)\quad I_L = E/\sqrt{R^2 + X_L^2} = E/\sqrt{R^2 + (\omega L)^2} = E/\sqrt{R^2 + (2\pi f L)^2}$$

Condenser loss which would appear as a resistance associated with C, has not been considered here because it is normally quite small.

With respect to phase, the line current I (the vector sum of Ic and IL) is:

$$(6)\quad I = E\sqrt{\left(\omega C - \frac{X_L}{R^2 + X_L^2}\right)^2 + \left(\frac{R}{R^2 + X_L^2}\right)^2}$$

The vector relations of Figure 3B apply. At resonance the line current is at its minimum value (IR). It is in phase with E and is equal to IR/R squared, plus (XL) squared.

The vector diagram of the series circuit is shown in Figure 3C. It should be noted that this diagram is similar to the diagram for the parallel circuit, except that the voltages replace the currents.

In figures 1, 2 and 3, capacitance associated with the coil in parallel resonant circuits is represented by the condenser component C.

Actually, however, C represents not just the capacitance of the condenser but the total capacitance acting in shunt with the coil. This includes (1) the actual condenser capacitance, (2) the distributed capacitance of the coil, and (3) stray shunt capacitance due to wiring and connections, all of which act in parallel to resonate the circuit.

Wherever C appears in the foregoing formulas it has the inclusive meaning:

$$(7)\quad C = C_c + C_d + C_s$$

Where:

C = total capacitance resonating the circuit,

C_c = condenser capacitance,

C_d = distributed capacitance of the coil, and

C_s = all stray capacitance due to wiring, etc.

For these reasons the coil L must possess a natural resonant frequency, even with no condenser as such connected across it, because the distributed and stray capacitances form with it a parallel resonant circuit.

It is highly important that these extra capacitances be kept as low as possible if consequential losses are to be avoided in receiver tuned circuits and full advantage is to be taken of the variable condenser range.

Hence, increased turn spacing or lattice winding is resorted to in efficient circuits to reduce distributed coil capacitance.

From equation (1) it is seen that in any variable condenser-fixed coil parallel resonant circuit the maximum and minimum frequencies at which the circuit may be resonated will be determined by the maximum and minimum capacitances in shunt with the coil.

Neglecting distributed and stray properties for the moment these limiting capacitances may be taken

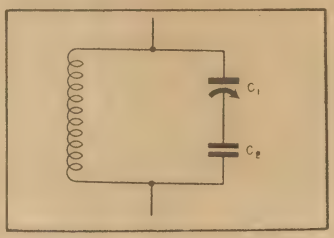


Figure 4: A condenser connected in series with a tuning condenser reduces its effective capacitance and also its effective tuning ratio. See test for the appropriate formula.

as those of the tuning condenser. The wider the capacitance range of the latter the wider will be the frequency band over which the circuit may be resonated.

Often in practice the maximum resonant frequency of a tuned circuit is chosen as some multiple of the minimum frequency. A ratio of 2:1 is quite common in some applications, although a higher ratio (about 3 to 1) is encountered in broadcast tuners.

In the case of amateur band-spreading the band of frequencies covered by the tuned circuits is only a few kilocycles wide, representing a ratio of little more than unity.

If it is desired to multiply or divide the resonant frequency of any parallel resonant circuit by any factor, and if the fixed inductance value, original frequency, and original capacitance are known, the capacitance of the condenser at the new frequency will be equal to the capacitance at the original frequency divided by the square of the difference factor, viz.:—

$$(8)\quad C_2 = \frac{C_1}{n^2}$$

$$(9)\quad f_2 = nf_1$$

Where:

C_1 = capacitance at original frequency,

C_2 = capacitance at new frequency,

f_1 = original frequency,

f_2 = new frequency,

n = factor by which the original frequency is to be multiplied.

Thus to double the resonant frequency (or to provide a tuning range of 2 to 1) the capacitance must be quartered — the tuning condenser must have a capacitance range of 4:1. Or to halve f, C must be quadrupled.

Within practical limits, any desired frequency range may be achieved by employing the condenser which gives the proper amount of capacitance variation in conjunction with the inductance capable of resonating at the band-limit frequencies.

It is obvious from the foregoing that the range of capacitance variation in the condenser will decide the frequency range of the tuned circuit and that any extension of the capacitance limits above and/or below normal will correspondingly widen or narrow the band of response.

In order to bring about such changes in the limiting values of C, mechanical alterations might be possible in the tuning condenser by the addition or removal of plates.

The same results may be accomplished electrically by interposing auxiliary condensers in series or

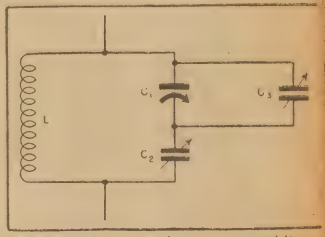


Figure 5: For special purposes, padding condensers in series and in parallel with the main tuning condenser can give a wide variation on effective total "C" and effective tuning ratio.

parallel with the main tuning capacitance to operate upon the latter's maximum and minimum capacitances, according to the following relations for the parallel connection:—

$$(10)\quad C_{min} = C_{min_c} + C_a$$

$$C_{max} = C_{max_c} + C_a$$

For the series connection:

$$(11)\quad C_{min} = \frac{1}{\frac{1}{C_{min_c}} - \frac{1}{C_a}}$$

$$C_{max} = \frac{1}{\frac{1}{C_{max_c}} + \frac{1}{C_a}}$$

Where:

C = resultant minimum or maximum capacitance,

C_c = condenser capacitance at maximum or minimum as indicated,

C_a = auxiliary capacitance.

From (10) a variable condenser having a maximum and minimum

(Continued on Page 89.)

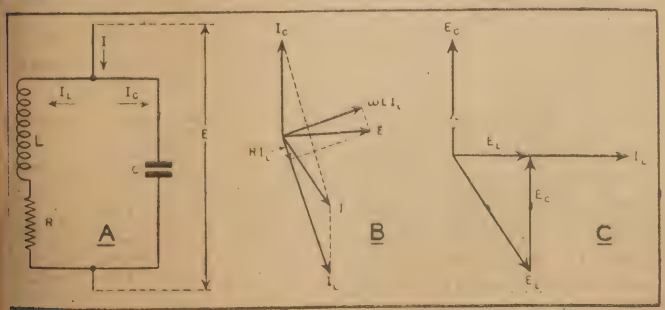
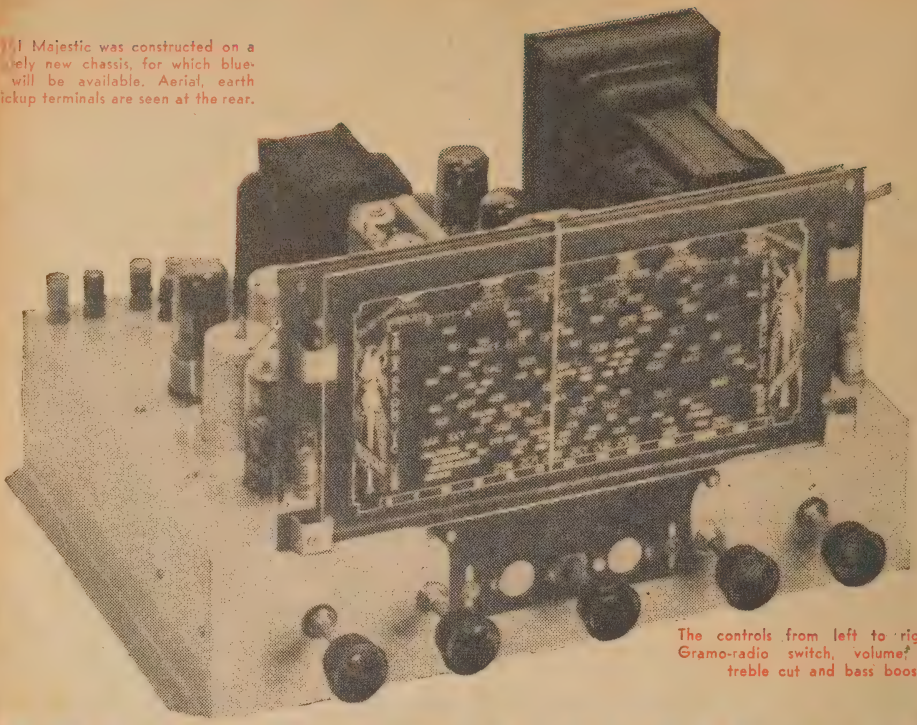


Figure 3: Showing how the resistive component in a practical tuned circuit modifies the current and voltage vectors. Most air-dielectric condensers have negligible losses.



The 1951 Majestic was constructed on a completely new chassis, for which blueprints will be available. Aerial, earth and pickup terminals are seen at the rear.

The controls from left to right are Gramo-radio switch, volume, tuning, treble cut and bass boost.

1951 MAJESTIC RADIOGRAM

If you can read a circuit diagram and use a few simple tools, you can also build yourself a quality receiver which will be better and cheaper than almost anything you can buy on the commercial market. This year's big set will play your normal records and broadcast stations to best advantage but it will also do justice to the microgroove records which have been announced for quantity release on the local market.

MOST our of sets have their origin in a matter-of-fact survey of seasonal requirements and the kind of designs which have or have not recently been covered. After checking with the trade about supplies, &c., we work out a circuit and layout and, within a few days, the new set is born.

The "1951 Majestic" had an entirely different beginning, when a very good friend of the editor suggested that it was about time we designed the kind of set that he personally wanted to build. It was said with just the right amount of emphasis to make us bite back.

"Okay then, what kind of set?"

"Well, a fairly big one that will sound good — radio and pickup."

"What kind of pickup?"

"Oh, it must be a lightweight . . . one that I can use on microgroove discs."

"Yes, but magnetic or crystal? That affects the whole design of the circuit."

"I don't know, frankly. I may want to use either. Can't you put in a switch or something? I don't want a set that only works with one kind of pickup! I might want to use either one later on."

"Well, yes, it could be done but it would mean an extra valve."

"Who's worrying about that? I'm just telling you what I want!"

"All right, then, do you want 807's in the output?"

"Heck, no! They're too big and expensive. Why not a couple of 6V6's? They'll make plenty of noise for me."

"TRF or superhet?"

"TRF definitely. I'm not interested in short-wave and distant stations. I just want the locals as well as you can give 'em to me."

"You'll run into trouble with joeys . . . unless we put in a whistle filter."

"Okay, then . . . put in a whistle filter."

"In other words you've forgotten all about the Junior Recorder in the April issue, which had most of the features you're talking about."

"On the contrary, it was the April issue that set me thinking . . . only I'm not interested in recording just now and I do want a bit more power output! What's more, it must go inside a cabinet and have a nice big dial . . ."

So the conversation went on, till we had a pretty clear picture of what this friend wanted. Tone control facilities, yes, but in moderation. Too many complicated knobs only confuse the rest of the family.

By the time our friend had finished his sales talk we had the feeling that plenty of other people would be interested in the kind of set he was talking about.

After that, it was merely child's play. Just a few dozen holes and cut-outs in a prototype chassis, a book full of data, a box full of bits and a solid fortnight of Ray Howe's time. Add to this our draughtsman

nd photographer, a concerted effort n the typewriter and the new set ecomes yours . . . as the "1951 Majestic."

Getting down to the circuit design, the tuner presents no special difficulty being a standard TRF arrangement with two RF stages and a diode detector.

The first valve is a 6SK7-GT, which has medium gain characteristics by modern standards. A high-gain miniature type could have been used, but space is not at a premium in this set and the additional gain is of little practical consequence.

SECOND VALVE

A diode-pentode is required for the second stage and our choice for this was another "-GT" valve, namely, the 6AR7-GT. The signal is passed from its plate circuit into the diodes, where it is rectified and the AVC voltage is generated.

Rude remarks are occasionally made about diodes and AVC circuits but the amount of distortion introduced by a well-designed system is of a very minor nature. It is more than outweighed by simplicity and convenience.

The two RF tubes have a common series-screen supply, which is arranged to be broken when the amplifier is switched for gramo. reproduction. A standing bias of approximately 2.5 volts is supplied to the grids from a back-bias source, which, thus, allows both cathodes to be earthed directly.

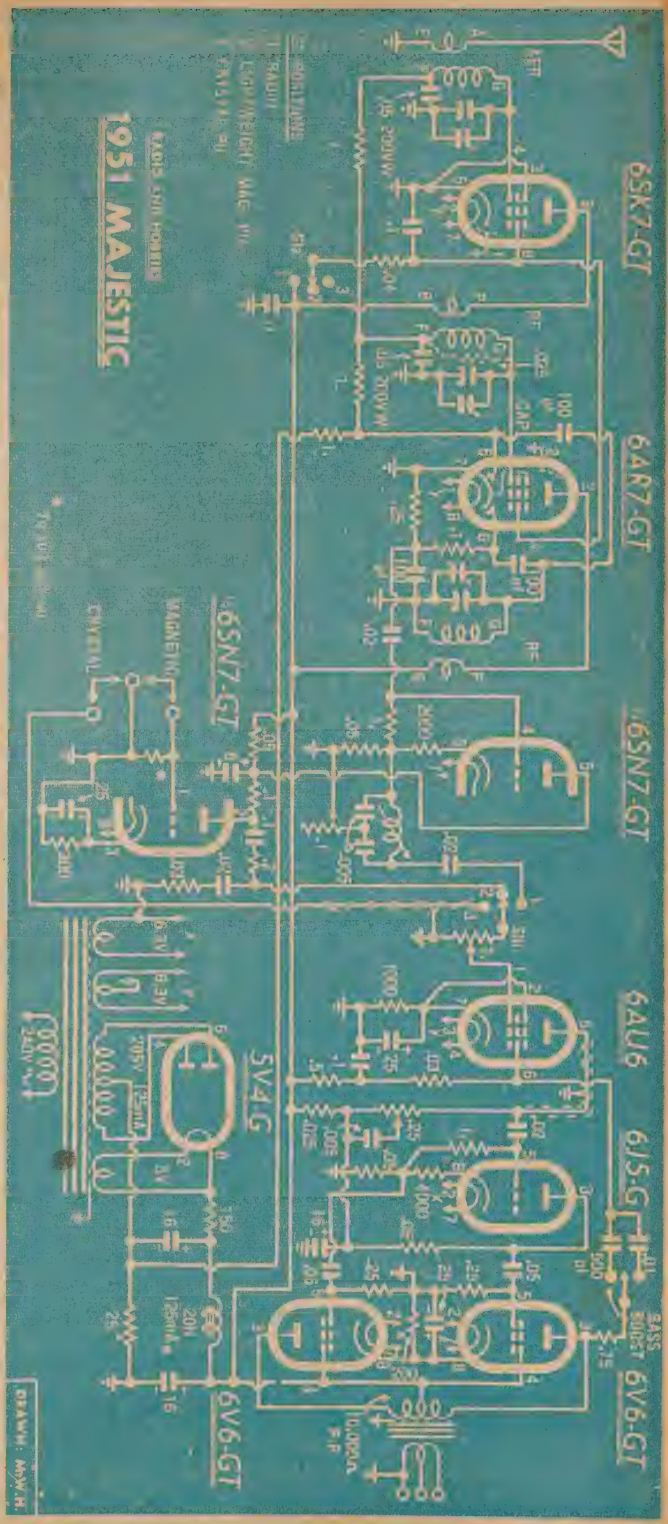
The full gain and selectivity of the tuner will not normally be required and, in fact, the selectivity will need to be reduced deliberately in the interests of wide-range reception. Many constructors seem to imagine that a TRF circuit is a sure guarantee of fidelity but such is not by any means the case. A partially regenerative TRF tuner can easily give a far less favorable selectivity curve than a well designed superhet.

In this case, we suggest loading the grid winding of the second RF coil with a resistor which can well have a value of about 25,000 ohms. The idea is to reduce the value of the resistor progressively until the tuner has only just enough gain and selectivity to receive and separate the local stations.

CIRCUIT LOADING

If you find that the loading resistor has to be ridiculously small before this condition is reached, loading may also be added across the first grid circuit and lastly, across the diode circuit. By following this technique, the pass band of the tuner will be widened appreciably and the high frequency sidebands admitted with the least possible attenuation.

The process, of course, leads to the immediate difficulty that heterodyne beat notes are heard between the strong local stations and weaker carriers spaced to 10kc on either side. The result is an annoying 10kc whistle, which varies with reception conditions, but which will always be

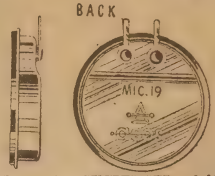


Here is the complete circuit diagram for the Majestic. Notable features are the whistle filter stage and the pre-amplifier stage for use with a low output magnetic pickup.

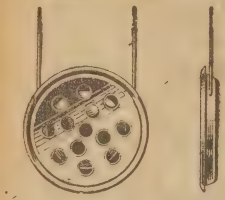
Choose your equipment from this famous range!

ACOS MICROPHONE INSERTS

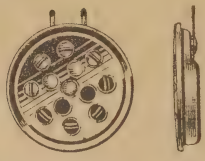
MIC. 3 DIAPHRAGM-ACTUATED crystal microphone, specially designed for the reproduction of speech frequencies. With rising response from 1000 c/s, this microphone has exceptional sensitivity.
Price: £1/18/-.



MIC. 19 SINTERCEL fulfils the requirement for a flat insert with good sensitivity and a frequency response 40/8000 c/s. Unaffected by vibration, exceptionally robust construction.
Price: £2/18/6.



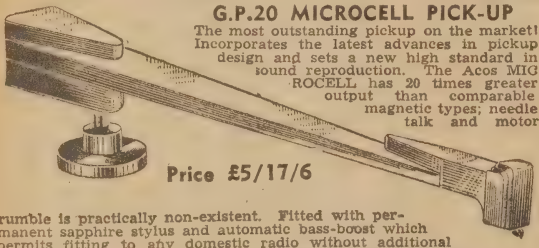
MIC. 18 MICROPHONE SPEECH INSERT provides high acoustic qualities with minimum bulk. Where exceptional slimness is required, this Insert is recommended.
Price: £1/19/6.



MIC. 14 STANDARD SPEECH MICROPHONE INSERT with nickel-plate brass case which gives high corrosion resistance, mechanical strength and rigidity.
Price: £1/18/-.

TYPE "A" MICROPHONE. Specially designed for clear production of speech. Ideal for public address; office and factory call systems; amateur and mobile radio transmitters, etc.
Price: £6/17/6.

G.P.20 MICROCELL PICK-UP



The most outstanding pickup on the market! Incorporates the latest advances in pickup design and sets a new high standard in sound reproduction. The Acos MIC ROCELL has 20 times greater output than comparable magnetic types; needle talk and motor rumble is practically non-existent. Fitted with permanent sapphire stylus and automatic bass-boost which permits fitting to any domestic radio without additional equalisers. Plays Microgroove or ordinary recordings. Available from all Radio Stores. .. .. Price: £5/17/6
CARTRIDGE ONLY (G.P.19) .. .. Price: £3/7/6

Price £5/17/6

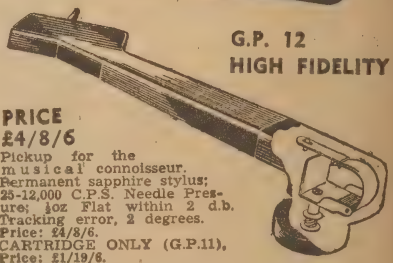
ACOS CRYSTAL PICK-UPS

G.P. 10 UNBREAKABLE PICK-UP

PRICE £2/19/9

Sturdy construction; ninety degree lift-back and exclusive needle pressure adjustment. Low Harmonic Distortion. Output 1.5 volt. Price £2/19/9.
CARTRIDGE ONLY (G.P.9) Price £1/15/-.

G.P. 12 HIGH FIDELITY



PRICE £4/8/6

Pickup for the musical connoisseur. Permanent sapphire stylus; 25-12,000 C.P.S. Needle Pressure; ½oz Flat within 2 d.b. Tracking error, 2 degrees.
Price: £4/8/6.
CARTRIDGE ONLY (G.P.11), **Price: £1/19/6.**

AMPLION (A'SIA) PTY. LTD., SYDNEY

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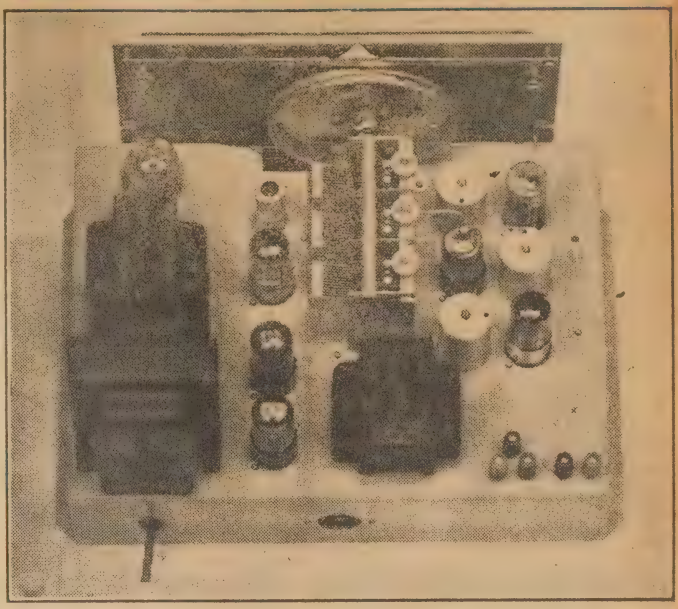
ere to annoy you. What's more, the etter you make the high frequency sponse, the worse the whistle will e.

Our answer to the problem is to t a special 10kc whistle filter, of e type which was first described connection with the R & H "Junior ecorder." It is fundamentally a Bridged T" network, operating in e output circuit of a cathode fol-wer stage.

While it might be possible to de-gn a filter to operate directly in ries with the diode output, the in-uctor would need to contain a very rge number of turns, becoming fficult to wind and liable to severe im pickup. For any given im-edance the coils must have the re-uisite number of turns and the con-ensers must be appropriately small value, otherwise the treble res-onse generally will be affected.

For practical reasons, therefore, the gnal is fed directly to a cathode llower, which maintains the same der of signal voltage but provides much lower source impedance. This

A REAR VIEW OF THE CHASSIS



The rectifier is in the front left corner; behind it the filter choke and power transformer. The output transformer is behind the tuning gang. Note the audio valves in line, while the RF section with whistle filter occupies the right-hand end of the chassis.

lows the use of a more conveni-it coil and standard condenser alues. An iron slug through the il allows it to be tuned exactly resonance, while the 0.1 meg. otentiometer is adjusted for maxi-um attenuation.

The specifications for the whistle lter are exactly as for the one used the "Junior Recorder" and we ive simply reprinted the same dia-ram. The only difference is a phy-cal one in that we reversed the ounting of the filter coil to bring e slug adjustment out alongside the otentiometer shaft.

A three-position tag strip was also oldered on to the cover of the poten-ometer to provide a convenient ounting point for some of the in-rnal connections.

Construction of the unit will call r a little extra time and ingenuity ut it is very well worth while in rms of the final result.

Viewing the audio requirements, ie amplifier may be required to perate from the detector output, om a crystal pickup or from a ghtweight magnetic.

The first two present no special roblem and it is merely a matter switching the volume control cir-uit from one signal source to the her. The special nature of a crys-l pickup ensures fairly high out-ut and also compensates quite well or the normal bass attenuation in andard recordings.

This is true of all ordinary crys-l pickups from the old-fashioned ariety to the very lightweight types ke the Acos GP-20. This latter ickup has interchangeable heads or standard and microgroove re-ordings and the natural bass com-ensation is operative in both types.

Magnetic pickups, as most readers ould know by now, lack the in-herent bass boost and high output of the crystal type, and are there-fore, somewhat less convenient to use.

They must be considered as important, however, because a good magnetic usually has a wider and flatter response than a comparable crystal pickup. But here is the vital point . . . the magnetic must be followed by a compensating stage which will boost its overall output and lift the bass register. Unless this is provided the output will sound woefully weak and thin.

The same remarks apply to nearly all lightweight magnetics, including the microgroove types and what one might term the "semi-lightweights" now fitted to record changers.

PARTS LIST

1 chassis 14½in x 10¾in x 3½in.
1 power transformer 285V a side at 125 mA, 6.3V CT 3A, 6.3V 2A, 5V 2A.(PF 152 or similar).
1 20 henry 125mA or 150mA filter choke.
1 output transformer 10,000 ohms CT to voice coil impedance (OP5 or similar.
1 standard 3-section gang tuning capacitor (AWA or Stromberg H).
1 dial to suit (EFCO USL 46).
1 broadcast aerial coil, 2 broadcast RF coils.
3 gang trimming capacitors.
7 octal sockets, 1 7-pin miniature socket with shield, 1 4-pin socket.
1 3-pole, 3-position, single gang wafer switch, 1 2-pole, 2-position, single gang wafer switch.

VALVES

1 6SK7-GT, 1 6AR7-GT, 1 6SN7-GT (or ECC33), 1 6AU6, 1 6J5-G (or any general purpose triode or triode-connected pentode), 2 6V6-GT, 1 5V4-G.

CAPACITORS

3 25 mfd 40PV electrolytics, 3 16 mfd 525PV electros., 1 8 mfd 525PV, 4 .1 mfd 400VW tubular, 2 .05 mfd 400VW, 2 .05 mfd 200VW, 4 .02 mfd, 1 .01 mfd, 3 .005 mfd, 1 .001 mfd, 1 500pf mica, 3 100pf mica.

RESISTORS

1 .75 meg ½w, 4 1 meg ½w, 1 .5 meg 1w, 1 1 meg potentiometer, 3 .25 meg ½w, 1 .25 meg potentiometer, 1 .2 meg ½w, 2 .1 meg ½w, 1 .1 meg 1w, 1 .1 meg potentiometer, 4 .05 meg 1w, 1 .04 meg 1w, 1 .03 meg ½w, 1 .03 meg 1w, 1 .025 meg 1w, 1 .025 meg ½w, 1 4000 ohm, 1 3000 ohm, 1 2000 ohm, 1 1000 ohm, 1 200 ohm 5 watt wirewound, 1 150 ohm 5 watt wirewound, 1 25 ohm 3 watt wirewound.

SUNDRIES

5 knobs, 2 dial lamps 6-8V .15A or .3A, 2 7-tag, 2 5-tag, 1 4-tag and 4 3-tag mounting strips, 1 1in threaded mounting pillar, 2 ¼in and 4 ⅜in rubber grummets, 4ft shielded wire, 5 terminals (1 red, 2 black and two other colors), power flex and plug, 1 small coil bobbin (RCS) (for whistle filter inductor), 1 iron-dust slug from discarded IF transformer, scrap aluminium for whistle filter bracket, 1 small size valve-grid clip, hook-up wire, spaghetti, solder lugs, solder, nuts, bolts &c.

STANDARD -FERGUSON- RANGE

POWER & VIBRATOR TRANSFORMERS

	A.C.	Vib.			Retail
PF 122	240	6	220	40	6.3V @ 2A	61/8
PF 125	240	6	250	60	6.3V @ 2A	71/11
PF 119	240	6	325	125	6.3V @ 4A	102/5
PF 182	240	12	200	40	12.6V CT @ 1A	61/5
PF 126	240	12	250	60	12.6V CT @ 1A	71/11
PF 146	200,30,40	12	325	150	12.6V CT @ 2.5A	120/9

FILTER CHOKES

	Induct	D.C. Res.	M.A.		Retail
CF 100	50	1900	10		33/8
CF 101	30	870	25		33/-
CF 102	15	300	60		25/8
CF 103	30	420	60		48/2
CF 104	30	580	75		51/2
CF 105	15	250	80		43/1
CF 106	12	200	100		43/8
CF 107	30	360	100		59/2
CF 108	12	135	150		61/7
CF 109	20	225	150		64/3
CF 110	12	100	200		74/8
CF 111	16	165	200		74/8
CF 112	10	70	250		74/8

SPECIAL CHOKES

					Retail
CF 113	.5	70	250		
	20		50	Swinging choke	82/-
CF 114	1.1	23	375	Ballast choke	51/3
CF 115	.017	.6	2 amps	L.T. choke	22/6

OUTPUT TRANSFORMER TO VOICE COIL
Full Frequency Range (30-15,000)

Code No.	Pri. Imped.	Sec. Imped.	Watts	Retail
OP24	5000 SE	8.4, 2.1, with feed back	5	77/-
OP23	3250 SE	12.5, 8.4, 2.1	10	112/3
OP19A	5000 PP	12.5, 8, 2.3	15	163/5
OP51	4500 PP	15.5, 12.5, 8.6, 2.7, 2	20	153/3
OP63	10000 PP	15, 3.75	15	174/6
OP64	10000 PP	12.5, 3.125	15	174/6
OP65	10000 PP	8.4, 2.1	15	174/6

OUTPUT TRANSFORMER TO VOICE COIL
Special Full Frequency (20-30,000)

OP25/40	10000 PP	40, 10	15	183/4
OP25/16	10000 PP	16, 4	15	183/4
OP25/15	10000 PP	15, 3.75	15	183/4
OP25/12	10000 PP	12, 3	15	183/4
OP25/10	10000 PP	10, 2.5	15	183/4
OP25/8.4	10000 PP	8.4, 2.1	15	219/6
OP66	5000 PP	8.4, 3.7	15	219/6
OP67	5000 PP	15, 6.5	15	219/6

OUTPUT TRANSFORMER TO LINE—
Full Freq. Range

OP22	3250 SE	500, 125, 2.3	10	112/3
OP19b	5000 PP	500, 250, 125	15	163/5
OP21	8000 PP	500, 250, 125	15	133/6
OP62	10000 PP	500, 125	15	174/6

OUTPUT TRANSFORMER TO LINE—
Special Full Freq. Range

OP25/500	10000 PP	500, 125	15	183/4
OP25/250	10000 PP	250, 62.5	15	183/4

VIBRATOR TRANSFORMERS

Code No.	Prl. V.	D.C. Out.	M.A.	Buffer Full Sec.		Retail
VT 100	32	200	40	.005	Sync.	50/9
VT 101	6	90	15	.008	"	39/11
VT 102	6	150	25	.005	"	46/6
VT 103	6	200	50	.005	"	49/-
VT 104	6	250	60	.005	"	50/2
VT 105	12	250	60	.005	"	51/11
VT 106	6	300	75	.008	"	82/10
VT 107	6	250	60	.005	Sync. Low Rad.	54/10
VT 108	12	90	15	.008	Sync.	41/5
VT 109	24	90	15	.008	"	43/9
VT 110	12	150	25	.005	"	49/-
VT 111	24	150	25	.005	"	53/8
VT 112	12	200	50	.005	"	51/4
VT 113	24	200	50	.005	"	51/4
VT 114	12	300	75	.008	"	89/3
VT 115	24	300	75	.008	"	90/3
VT 116	24	250	60	.005	"	57/2
VT 117	12	250	60	.005	Non Sync. Low Rad	55/5
VT 119	32	150	25	.005	Sync.	49/2
VT 121	6	180	30	.005	"	51/4
VT 122	6	400	50	.005	"	83/10
VT 123	12	320	125	.005	Sync.	107/10
VT 124	32	250	60	.005	"	56/-
VT 127	6	200	50	.005	Sync. Low Rad.	51/4
VT 128	12	250	60	.005	Sync. Low Rad.	60/8

RECEIVER POWER TRANSFORMERS

Code No.	Prim.	HTV Aside	M.A.	Filaments	Retail
PF 185	240	150	30	6.3V @ 2A	50/2
PF 106	240	325	45	6.3V @ 2A, 5V @ 2A	53/11
PF 198	240	285	50	6.3V @ 2A, 5V @ 2A	50/2
PF 151	200,30,40	285	60	6.3V @ 2A, 5V @ 2A	60/8
PF 165	200,30,40	385	60	6.3V @ 2A, 5V @ 2A	66/6
PF 170	200,30,40	285	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	72/2
PF 168	200,30,40	385	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	69/5
PF 130	200,30,40	285	100	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	77/9
PF 160	200,20,40	385	100	6.3CT @ 2.5A, 6.3V @ 2A, 5V @ 2A	87/3
PF 152	200,30,40	285	125	6.3CT @ 3A, 6.3V @ 2A, 5V @ 2A	97/6
PF 181	200,30,40	385	125	6.3CT @ 3A, 6.3V @ 3A, 5V @ 2A	109/2
PF 174	200,30,40	285	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	102/5
PF 175	200,30,40	385	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 3A	127/9
PF 173	200,30,40	425	175	6.3CT @ 3A, 6.3V @ 2A, 5V @ 3A	197/9
PF 140	200,30,40	385	200	6.3CT @ 3A, 6.3V @ 3A, 5V @ 3A	185/-
PF 171	200,30,40	385	250	6.3CT @ 4A, 6.3V @ 3A, 5V @ 3A	243/7
PF 201	240	225	50	6.3 @ 2A	51/1

LINE TO VOICE COIL TRANSFORMERS

	Pri. Imped.	Sec. Imped.	Watts	Retail
MT111	500	12.5, 8, 2.3	10	69/1
MT100	600	4, 3	15	64/2
MT101	500	15	15	64/2
MT124	600, 500	4, 3, 2.7, 2.3, 2	25	107/10
MT125	600, 500	15, 12.5, 8.4, 6.5	25	105/2

MODULATION TRANSFORMERS

MT118	8000, 6000 PP	10000, 7000 5000	25	169/4
MT119	8000, 6600, 3800 PP	10000, 7500, 6500 5500, 4500, 3500	50	195/1
MT120	500 to 20000 in steps.	500 to 30000 steps.	50	356/10
MT121	500 to 20000 in steps.	500 to 30000 steps.	125	444/-

Output Transformer To Voice Coil—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1	5000, 2500 SE	12.5, 8, 2.3	10	71/3
OP54	5000, 2500 SE	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	10	82/3
OP39	5000, 2500 SE	15	10	72/6
OP33	5000, 2500 SE	5, 2.7	10	72/6
OP41	5500 SE	3.7	10	81/1
OP53	30000, 20000 14000, 10000, 7000 5000, 2500 PP	2.3	10	70/1
OP2	5000 PP	12.5, 8, 2.3	15	109/11
OP55	5000 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	15	120/5
OP3	6600 PP	12.5, 8, 2.3	15	109/11
OP56	6600 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	15	120/5
OP4	10000 PP	12.5, 8, 2.3	15	109/11
OP57	10000 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	15	120/5
OP5	10000, 6600, 5000 PP	12.5, 8, 2.3	15	109/11
OP58	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	15	121/11
OP59	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	25	152/9
OP60	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	32	195/-

OUTPUT TRANSFORMER TO LINE—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1A	5000, 2500 SE	500	10	71/3
OP44	5000, 2500 SE	500, 250, 125	10	84/8
OP34	5000 PP	600, 300, 200, 150, 130, 100 75, 50	15	131/-
OP6	5000 PP	500, 250, 125	15	109/11
OP7	6600 PP	500, 250, 125	15	109/11
OP50	8000 PP	600, 300, 120, 60, 30	15	228/4
OP8	10000 PP	500, 250, 125	15	109/11
OP8M	10000 PP	500, 250, 160, 125, 100, 83.5 71.5, 62.5, 55.5, 50	15	118/6
OP9	10000, 6600, 5000 PP	500, 250, 125	15	109/11
OP10	5000 PP	500, 250, 125	25	132/6
OP11	6600 PP	500, 250, 125	25	132/6
OP38	6600 P	600, 300, 250, 200, 170, 150 76, 50, 36, 27, 12.5, 7.5, 3.6, 2.7	25	228/4
OP12	10000 PP	500, 250, 125	25	132/6
OP13	10000, 6600, 5000 PP	500, 250, 125	25	132/6
OP35	10000, 6600 PP	500, 4000, 8.4, 2.2	25	187/4
OP14	5000 PP	500, 250, 125	32	161/-
OP48	6600 PP	140, 70	32	195/1
OP15	6600 PP	500, 250, 125	32	161/-
OP15M	6600 PP	500, 250, 166, 125, 100 83.5, 71.5, 62.5, 55.5, 50	32	162/6
OP16	10000 PP	500, 250, 125	32	161/-
OP17	10000, 6600, 5000 PP	500, 250, 125	32	161/-
OP36	3800 PP	17.6	60	171/-
OP18	3800 PP	500, 250, 125	60	173/4
OP61	3800 PP	100, 75, 50, 25, 10, 5, 2	60	223/-
OP37	6400 PP	500, 250, 125	80	236/3
OP49	8800, 6000 PP	500	105	355/10
OP20	11600, 8400 PP	500, 250, 166, 125	150	451/-

ALL PRICES SUBJECT TO ALTERATION WITHOUT NOTICE

In the normal way, the position an only be met by providing an dditional stage ahead of the main mplifier and used only for the mag- etic pickup channel.

To save allotting a valve for this ob only, we have specified a 6SN7- T twin triode. One section is used or pickup compensation, the other erving as the cathode follower hich feeds into the whistle filter.

The constants in the plate circuit f the compensating stage have been rranged to give most of the bass oost which will be required and a ttle extra gain at middle fre- uencies. The potential gain of the ube has to be proportioned between he two functions and the conditions uggested in the circuit represent a ood average compromise.

If you have different ideas on the bject, however, you can increase he bass boost at the expense of over- ll gain by replacing the .03 meg. esistor with a lower value. In- reasing the value of this resistor ill raise the overall gain but de- rease the effective bass boost.

ADIO GRAMO SWITCH

The ultimate output from this tage is taken to one of three posi- ons on the input selector switch.

From then on, the amplifier is airly conventional, following the attern of voltage amplifier, phase plitter and push-pull output. Feed- ack is taken from the plate of one utput valve to the screen of the oltage amplifier and provision is ade in this network to reduce the eedback at low frequencies.

Chief purpose of this provision is o allow the bass to be boosted for ow-level listening, under which con- itions the reduction of feedback is ot likely to be a serious factor. For ormal high level listening, the "bass oost" would not be needed.

The treble control is a conventional op-cut affair operating in the plate ircuit of the voltage amplifier. This, oo, will have its uses with programs r records that are not as clean as hey might be at the top end.

You will note that the voltage am- lifier and phase splitter have been ecoupled to remove the last ves- ige of hum. This, with the normal iltering in the power supply cuts he hum to the point where it is vir- ually inaudible right in front of the peaker.

CONSTRUCTIONAL HINTS

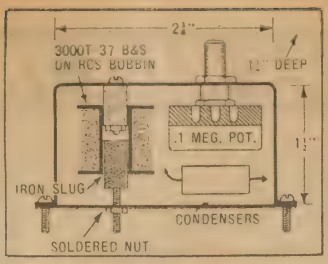
So much then for the circuit.

Try as we might we were unable o avoid introducing a new chassis esign. There is nothing special bout this one except that the holes re in the positions where they are anted.

The underneath and rear top hotographs give a clear indication here the major components are ocated and a good guide to the lacing of the minor components. Ve suggest that you locate the valve ockets and the coils in the following ositions—the 6SK7-GT socket key- ay towards the whistle filter, the AR7-GT and the 6SN7-GT towards he rear centre, the 6J5-G, 5V4-G nd the 6V6-GT's towards the power ransformer, the gap between pins 1 nd 7 of the 6AU6 towards the dial.

In the case of the coils, position he grid pins of the aerial and econd RF coils towards the gang nd that of the first RF coil away rom the gang.

The use of tag-mounting strips ather than resistor boards or strips



Here is a diagram of the whistle filter unit. Note that for this set the mounting of the inductor should be reversed so that the slug protrudes on the same face as the potentiometer shaft.

makes for easier wiring and placing of components. Place solder lugs under the appropriate nuts holding major components or valve sockets and wire all such "earth" points together with a run of light gauge tinned copper wire.

A tie point for the output of the cathode follower is provided by screwing a 1in length of ¼in threaded mounting pillar on to the inside mounting bolt of the 6SN7-GT socket. This carries the junction of the 1 meg., the .05 meg., the 2000 ohm and the lead to the whistl filter.

The remainder of the component associated with the 6SN7-GT a located at the socket and on tw tag strips on the side of the chass close to the socket. On these tw 7-tag strips, in order from the bot tom near the socket, is the .02 mfd coupling, the .1 mfd., the .2 meg the .02 mfd., the 25 mfd. with th 3000 ohm, and the 8 mfd.

In laying in the shielded wirin from the pickup terminals to th 6SN7-GT socket and to the switc from the switch to the volume con trol and from this control to th 6AU6 socket, cut the wire to lengt and slip some spaghetti over it be fore soldering into place. Earth th braid at the 6SN7-GT socke and at the 6AU6 socket. The earth terminal associated with the pick ups is insulated from the chassi and carries the connection to th braids at that end of the runs.

While on the matter of shielde wire, use it for the connection o the .25 megohm tone control to the plate pin of the 6AU6 and earth the braid at the socket. This wil then act as an RF bypass for tha stage.

There is little in the circuit align ment that the uninitiated could no pick up within a few minutes o twiddling. Set the dial travel in

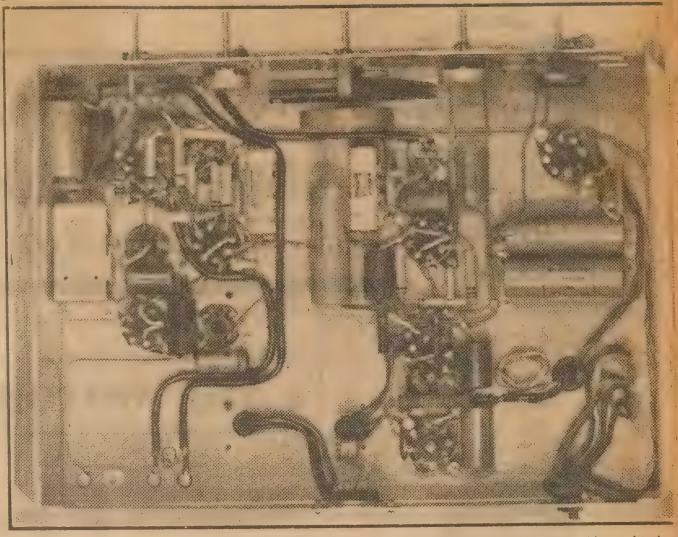
relation to the gang so that there is equal overlap of the pointer at each end. It should be noted that the dial drum is "floated" on the gang spindle by removing the screw holding it to the dial back-plate.

It is then simply a matter of tuning in a station near the low frequency end of the dial, adjusting the coil slugs to bring it in at the correct spot. Adjust the slugs of the three coils for maximum volume from this station. Swing down towards the high frequency end of the dial and adjust the trimmers mounted across each section of the tuning gang until a selected station tunes in on its correct spot, peaking all three trimmers for maximum volume. The final step is to repeat this operation. The .025 megohm "damping" resistor can then be connected across the G and F pins of the second RF coil.

Accurate alignment can be obtained by connecting a 1 mA meter in series with the 1 megohm AVC diode load resistor and its connection to the back-bias network and adjusting for maximum deflection.

The whistle filter adjustment is also quite simple. Tune to a spot on the dial where this 10 kc adjacent-channel beat is most evident and set the potentiometer in the whistle filter bracket to an initial figure of about 25,000 ohms. Adjust the position of the iron slug in the inductor until the whistle drops in level, readjusting the pot. for the greatest "dip." You will find an adjustment for the iron slug and the pot. where the whistle disappears either completely or to a negligible level.

UNDERCHASSIS OF THE MAJESTIC



The location of most components can be seen in this underneath view. The whistle filter is at the left hand end. Note that the secondary tappings on the output transformer are taken to a 4-pin socket on the rear face.

The final positions, particularly that for the pot., will be found to be quite critical but once set should not need further attenion if a drop of coil dope or nail lacquer is deposited on the pot. shaft and around the slug thread where it enters the bracket.

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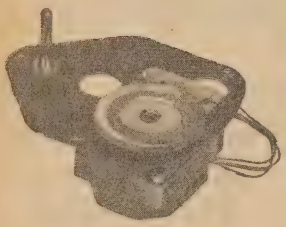

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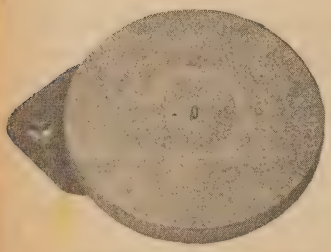

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LEARN WHILE YOU BUILD

(Continued from Page 39)

happen if it were not for the condenser. Its value is such that it will charge or discharge much slower than the rate of current change, and so it maintains the voltage across the resistor at an essentially constant value.

So much then for the circuit. Let us now consider some of the constructional details. First thing to be done is to mount the filter choke, and this is best located against the end of the chassis directly below the power transformer. It may be necessary to rearrange the position of one filter condenser, and two small mounting holes will have to be drilled in the side of the chassis. Make sure that the selected position is quite clear of the tag strip terminating the power leads.

6V6 SOCKET

Next mount the socket for the 6V6, locating the filament pins toward the rear of the chassis. A tag strip is also required near this socket and is most conveniently mounted under the nut on the coil can stud. The phone terminals are no longer required, but it may be a good idea to simply disconnect them and leave them mounted, as we may have another use for them later.

Above the chassis, the main consideration is the speaker, and the actual method of mounting will depend largely on the type selected. The Amplion or Magnavox types will mount directly on the chassis, two of the speaker mounting holes corresponding with two holes in the front of the chassis.

With most other types the holes will not match directly, and it may be necessary to make up some kind of bracket or plate to accommodate the different hole positions. It would be possible to mount the speaker directly on the panel or front of the cabinet, but this will mean an extra long speaker lead to allow the set to be taken out of the cabinet, and is not as neat an arrangement as making the whole thing as one unit.

In any case, an opening must be cut in the front panel to let the sound through, and this may be as simple or elaborate as your taste and skill dictates. The pattern shown in the photographs is quite effective, well within the scope of ordinary wood-working tools, and not particularly difficult. After cutting it we glued a piece of speaker silk to the rear, first pinning it into simple pleats to make it more attractive. (Sounds like instructions for the new look doesn't it!)

BAFFLE BOARD

With the speaker mounted on the chassis, there will be a space between it and the front panel (or cabinet) which is very undesirable if the best results are to be obtained from the speaker. To overcome this, it will be necessary to make a small baffle about 6 inches square and having a circular opening of about 4½ inches diameter. It will need to be thick enough to fill the space between the speaker and panel. A piece of half-inch Caneite is just about ideal but, if this is not available, two thicknesses of plywood may be used.

One corner of the baffle may have to be cut to clear the volume control shaft, and a hole will be required to pass the panel mounting bolt which also holds one of the lower corners of the speaker. The baffle should first be attached to the speaker by means of wood screws or machine screws through the two upper holes, after which the panel may be fitted back into place.

You're probably wondering why we are going to such trouble to fill the gap between the speaker and the panel, and it is really too big a subject to deal with fully at the moment. Briefly, however, it is necessary to prevent interference between the front and rear waves of the speaker which otherwise reduces the efficiency. This effect is most pronounced at the lower frequencies, so that the better the baffling the better the low note response.

About the only other constructional detail is the making and fitting of a small shield around the 6AR7. Before this was fitted we found that there was a slight hum level, not very high, but just enough to prevent the set being used at low volume close to the ear, as might be convenient if used as a bedside set. Part of this was due to the grid leak, and placing it against the frame of the tuning condenser effected some improvement, but the larger portion was not removed until the valve was shielded.

VALVE SHIELD

A small scrap of aluminium about an inch and a half wide and three and a half long was bent into a semi-circular shape to fit around the valve. One side was bent at right angles and drilled with a 1/8" clearance hole so that it could be bolted to the frame of the tuning condenser. The general idea can be seen in the rear-view photograph. This is something which can be left until you have the set working, as it will not affect the performance for general listening.

The wiring should not present any great difficulty, and reference to the circut and under-chassis diagram should provide all the information required. Incidentally it's about time you were able to do all your wiring from the circuit diagram alone—try it!

With all wiring complete and carefully checked, you can switch on and give it a test. The operation of the controls should be much the same as before, the only real difference being the addition of the volume control. This is really necessary as there are plenty of occasions when the signals are louder than required and, if the volume is reduced by decreasing the regeneration, selectivity is likely to suffer. As it is, the regeneration can be set to the maximum position at all times and the volume adjusted independently.

When working correctly, you should have no difficulty in receiving all the local stations at adequate volume unless your location is a particularly bad one. However, we would stress once again the need for careful selection of aerial length, or alternatively the coupling to the aerial by means of a small fixed condenser, as this can make a tremendous difference to the performance of a set of this kind.

Here's your answer, Tom!

It's just as well Tom seeks our advice, for he could land in a great deal of trouble, given the wrong information. Just think of the complications which could arise had he been allowed to go on through life without an answer to the first question.

What is the difference between an oscillator and an osculator?

There may not be such a great deal, Tom, because both are difficult to stop once they get going properly. First of all, Tom, to oscillate simply means to vibrate. Excellent examples of oscillating objects are Sydney's rams—with due apologies for bringing the subject up again.

In a radio sense a valve may be induced into a state of oscillation by feeding some of the energy from its output circuit back to the input circuit. In certain cases we require valves to oscillate for special purposes but more often we simply want them to amplify a signal of some sort without introducing any extraneous signals on their own initiative.

As often as not, or so it seems, beginners find that one of the valves persists in oscillating when it is not supposed to. The result is a series of howls and whistles and squeals which entirely spoils the program you are trying to enjoy.

Take the set along to a technical wise-guy and he'll tell you that the set is "unstable," that it needs an extra bypass here and there or that certain leads will have to be made shorter.

But the best radio doctor in the world wouldn't be much help with a bad case of osculation. You see, Tom, to osculate means to kiss.

What are the essential differences between a receiving valve and a transmitting valve?

If one might persist in being facetious, Tom, it could be said that the chief difference is that transmitting valves are used in transmitters while receiving valves are used in receivers. Actually the statement isn't as silly as it might sound.

The line of demarcation between the two is not at all clear, for most of the valves used in transmitting stations are small types exactly the same as used in receivers and amplifiers. It is only in the latter stages of a transmitter, where a large amount of power is handled, that special valves have to be employed—simply because the receiving types aren't big enough for the job.

It would therefore be roughly correct to say that the "transmitting" classification includes all valves which are larger than those normally employed in receivers.

Transmitting valves come in various shapes and sizes, partly because they are designed for special jobs and partly because the need for standardised bases and suchlike is not quite so important. In fact, plenty of transmitting valves have no bases at all, the electrodes being brought out to caps and leads wherever it suits the designer best.

Otherwise they are simply diodes, triodes, pentodes, &c., just like receiving valves but larger and capable of handling lots of power. Of course there are in-between types which are used for all kinds of purposes.

Type 807 is a notable case of a transmitting valve which finds ready application in receivers and amplifiers, especially since it has been available for some time from surplus war stocks and at a specially reduced price.

What is a Heaviside layer?

An obese fowl, Tom, or a layer that is a bit on the heavy side.

The Egg Board would like to get hold of a few so that we can step up our exports to Britain—or even have a few eggs for ourselves!

Seriously, Tom, Heaviside was a British scientist who in the early years of this century put forward a theory to account for the transmission of radio waves around the curved surface of the earth. He suggested that there is a medium which is capable of reflecting the waves in the upper layers of the earth's atmosphere.

The idea is that radio waves leave the transmitting aerial at an angle and go out from the earth's surface until they strike the reflecting layer, when they are again returned to earth, perhaps many thousands of miles distant from their starting place. But for this layer, long distance radio communication would not be possible.

If you care to check through the chapters on high frequency communication in any of the standard handbooks you will find plenty of information on this very interesting subject.

By the way, the reflecting layer is more correctly known as the Kennelly-Heaviside layer, since an American scientist, Kennelly, put forward the theory at the same time as Heaviside.

The circuit of the "Senior Portable" shows an AVC connection to the tuning gang. I would be obliged if you could explain this and tell me how to connect it.

Quite frankly, Tom, we don't follow your line of reasoning.

In the case of the "Senior Portable," the AVC line, coming from the first IF transformer makes connection with the AVC lug of the aerial coil and the AVC bypass condenser C1. The latter is connected directly from the lug of the coil to earth.

The only explanation for your difficulty that we can suggest is that you have confused the AVC bypass condenser with the tuning condenser.

HELP FOR "TOM"

Mr. E. Hough, of 1 Berring Av., Lakemba, NSW, has written to say that he has two electro-dynamic speakers which he wants to give away. One is a 10in, the other a 9in and Mr. Hough says that the first two lads to call can have them . . . but they must be schoolboys not yet earning appreciable income.

That strikes us as a very nice gesture on the part of Mr. Hough. He may have started something. Maybe other readers have other bits of gear which could encourage a lad in his hobby!

The tuning condenser is always drawn, in Radio and Hobbies circuits at any rate, with the movable plates as a curved arrow, while fixed condensers are represented by two heavy parallel lines. Trimmer and padder condensers are drawn the same way, if they are fixed types or with the curved arrow if the value can be varied. Sometimes parallel lines, with an arrow passing obliquely across them, are used to indicate partially variable capacitors.

You can't go wrong if you remember that a variable condenser is indicated by the arrow. Much the same applies in the case of coils and IF

ransformers, where arrows may be sed to indicate that the value of inductance is variable or that the mutual coupling between two coils is ariable.

In the case of the "Senior Portable," the windings of both IF transformers and the secondary windings of the RF and oscillator coils are provided with iron dust slugs, so that the inductance may be varied. These are omitted from our circuits, together with the fixed shunt capacitors in the case of the IF transformers, to avoid unnecessary complication.

I would also like to know how to connect the aerial and earth into the circuit of the "Senior Portable."

Most manufacturers of loop aerials provide a winding to which an external aerial and earth can be connected. If not, however, it is simply a matter of winding two or more turns concentric with the loop and close to it. The exact number is not critical, but you can easily experiment for best results with a particular receiver/aerial combination.

Note that it is almost essential to use an earth wire if a worthwhile improvement in results is to be obtained. It does not much matter which end of the coil is connected to earth.

I wish to connect a 12in extension speaker to my mantel receiver, which is equipped with a 5in speaker. Both speakers have voice coil impedances of 2 ohms and I can obtain a transformer which will match the output valve to 3½ ohms. Would the ½ ohm difference affect the volume, distort the reproduction or damage the valve.

You can make the extension speaker work quite well without even buying the extra transformer, from, but before that, some remarks on loudspeaker matching in general . . . .

The load required by a receiver output valve is not as critical as many people seem to imagine. For instance, in our own laboratory we have many times connected a receiver to a test speaker fitted with a switched primary circuit so that the impedance reflected to the valve may be varied over wide limits. Without the aid of instruments it is quite difficult to detect any difference in the output, even when the impedance is raised or lowered by a factor of five times. It is understood, of course, that the output valve is delivering ordinary room volume on either speech or music, which is far below the maximum output of which the valve is capable.

In your case, Tom, we suggest that you simply connect the voice coil of the extension speaker in parallel with the existing speaker. The load presented to the output valve will be only half normal, but it's our bet that you won't notice the difference in the quality.

If you are building a set to make provision for an extension speaker you would buy a transformer designed to reflect a slightly higher than recommended primary impedance, so that the mismatch is not so great when the second speaker is connected.

You may find that the volume from the extension speaker is much greater than from the main speaker, in which case it is quite an easy matter to insert a small value of resistance in series with the line.

Developing this scheme a step further, you could take the secondary winding of the output transformer to a pair of potentiometers, 6 ohm wire-wound types would be suitable, and connect the speaker voice coils between the moving arms of the pots. and one side of the line. It would then be possible to adjust the volume balance between the two speakers to suit your own requirements.

To answer your specific question about the ½ ohm mismatch in a secondary circuit, it would have none of the dire effects you are worried about. However, for various reasons, it is nearly always desirable to wire multiple speaker circuits in parallel rather than in series, where practicable.

I used to think that the more valves there are in a set the better its range. However, I recently saw a one-valve receiver described in a magazine and the article claimed a world-wide range. If the number of valves is not responsible, what is?

There is one thing we had better straighten out, Tom, before going any farther and it concerns the matter of receiver range. Radio salesmen, interested in sales figures rather than technical accuracy, have left a legacy of wrong ideas for some of our less experienced readers by talking about receivers having such-and-such a range.

The other day we noticed an advertisement for a small dual wave mantel receiver in which the manufacturers guaranteed a range of 12,000 miles. No one could dispute the truth of the advertisement because at some time of the day the salesman could turn the set on and demonstrate its ability to receive a short-wave station 12,000 miles away.

If this little set, no doubt an excellent piece of radio engineering within the scope of four valves, can receive signals from the most distant spot on the earth why bother about elaborate and expensive jobs with umpteen valves?

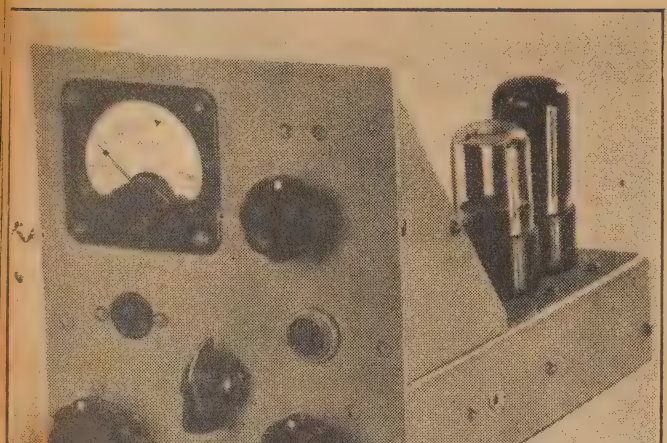
The answer is to be found at the transmitting rather than the receiving end. Some of the overseas stations, particularly in England and America, and more recently Russia, pump such terrific signals into this country that it is possible to hear them on a small set.

The precision multi-valve jobs are only required to "do their stuff" when the signals are weak and suffering from interference.

Many of the extra valves used in such sets are included to work some of the auxiliary devices and do not amplify the signal at all. For example, one well-known noise limiter circuit requires a total of three valves, while crystal bandsetting oscillators and signal level meter circuits usually require one or more valves, all of which help to swell the grand total.

Apart from its ability to amplify weak signals a high performance receiver would have good selectivity and the ability to stay tuned accurately to the same frequency over a long period of time.

After all, you can get a jalopy for a few pounds and a Rolls-Royce for a few thousand. Both motor cars, but what a difference!



The front view shows the aerial input socket and regeneration control below the meter. Tuning knob is top left above the mike socket and audio control. Switch is in the centre. Chassis is 8 x 5 x 1¾in, panel 5½ x 6¼in.

A 576MC TRANS-RECEIVER

Last month we had something to say about simple transmitters for the 576 mc amateur band. This month we have some observations about receivers, illustrated by a trans-receiver we have used in our own experiments.

by John Moyle

PROBABLY the best way to talk about receivers would be to describe the equipment, which procedure will take in most of the points to note in a standard approach, plus a few ideas we have accumulated ourselves.

The idea of this combination transmitter receiver was to make a job economical of parts and which would take up little room.

In general, the transmitter employs a pair of RL18 valves in a modulated oscillator circuit similar to that described last month. It is modulated by a 6V6GT driven from one half a 6SL7 — a high gain dual triode producing enough lift to enable a standard crystal microphone to be used.

The modulation transformer is a centre-tapped push-pull speaker transformer, the second half of which is connected to the oscillator. Thus the plate current of the 6V6 and that of the oscillator more or less balance out and avoid core saturation.

THE RECEIVER

The receiver uses a 955 as a self-quenched super-regenerative detector, choke-coupled to the second half of the 6SL7. When receiving, the 6V6 grid circuit is switched across to this section, the oscillator is disconnected, and the voice-coil winding of the speaker transformer connected to the speaker voice coil.

This dual use of components is why the job is really a trans-receiver and not a transceiver.

The entire switching is carried out by a double-bank switch, each bank being of the 3 x 3 type, although only two positions are used in each section — one for transmit and one for receive.

The same switch is used to connect the aerial to transmitter or receiver, in a manner to be described later.

The RL18's are mounted vertically so that the plate lecher is above the chassis just below the meter, and the cathode lines are beneath the chassis. The plate lecher is supported by a small polystyrene block. It is made of 1/8 inch silvered copper tubing which is a tight fit in the block. Any good insulating material may be used for this block, but poly. or ceramic is the best. The mounting should be firm to avoid straining the valves.

The cathode lines are mounted near the valves in the same manner, and the far end soldered to a bolt connected to the chassis for earthing.

The grid pins are soldered together, and to the grid leak which is supported on a small strip. It is earthed through the meter to read grid current.

AERIAL LEADS

The aerial lecher is soldered at the bend to another bolt through the chassis, and is tuned by a two-plate condenser made of two discs about ½ inch diameter.

One is soldered direct to the lecher, and the other to the end of a bolt which screws through a large nut soldered to the other lecher line. A tight fit in the nut is essential — one of those "anti-rattle" nuts is ideal as long as the bolt makes contact with it, and is not insulated by the "anti-rattle" compound.

The aerial leads solder direct to the aerial lechers, and the whole makes quite a neat little job.

The mike input is shielded right up to the input socket. Switching in this circuit produced hopeless feedback, which is why the switch was removed to the 6V6 grid circuit, and the twin-triode used.

A carbon microphone can be employed working directly into the 6V6 grid circuit through a transformer, mike current being taken from portion of the 6V6 bias resistor, which is split into two sections—200 and 100 ohms — for the purpose.

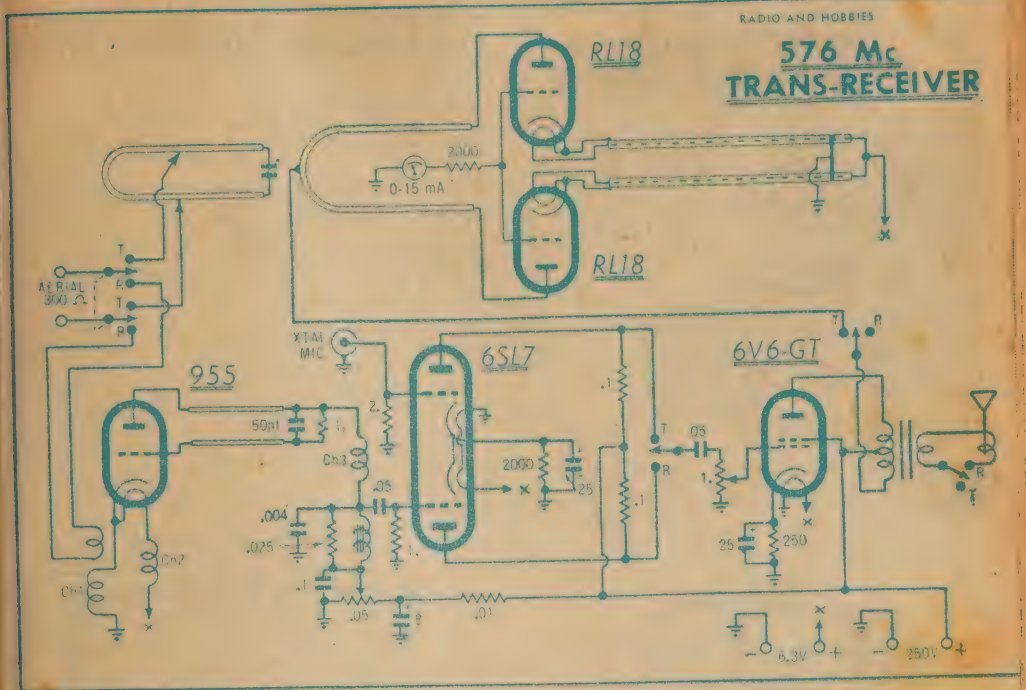
The 955 seems to work quite well in the receiver circuit, although it is quite near its maximum frequency. Again lecher lines are used of the quarter-wave type, the grid leak and condenser being connected across the cold end. Returning the grid leak to high tension generally assists super-regeneration, although some valves work best with an earth return.

EXPERIMENT NEEDED

Some experiment is nearly always needed to get best results from the valve, and some won't super-regenerate at all. Condenser values as low as 5 pf and resistors up to 5 megs may be tried—there is no hard and fast rule. All our valves worked best with the values shown.

Up to 120 volts or so may be needed for super-regeneration, par-

CIRCUIT DIAGRAM OF 576 Mc TRANS-RECEIVER



The circuit diagram is equally suited to 144 mc as to 576, using tuning coils instead of lechers. Power supply is normally 200-250 volts. Ch 1 and 3 have 6 turns 3/16in diameter, and Ch 2, 3 turns ¼in diameter.

ticularly with a heavy aerial load, although some valves will work as low as about 80 volts. Once again, the only safe rule is to experiment.

The super-regenerative detector isn't a mystery, and the desirable conditions for best results are well known. Unfortunately with the self-quenched type, each adjustment is a compromise with almost every other adjustment, so that the cut-and-try method, rough though it may appear, is about the only practicable course to take. When space permits, we may be able to examine the operation of various circuits in more detail, but the beginner is probably wisest to start out with the self-quenched type.

SHAFT MOUNTING

To facilitate tuning, the lechers are mounted vertically, and are soldered directly to the pins of a small acorn socket which, in turn, is held to the panel bracket by a small angle bracket of its own. Tuning is done by screwing a small metal disc about one inch diameter to and from the lechers. The disc is soldered or otherwise fastened to the end of a ¼ inch fine threaded bolt which screws through a block of insulating material such as hard rubber.

A slot is cut through the bolt hole, and part way down the block so that another 1/8 inch bolt running through at right angles can be used to cramp the control shaft more or less tightly to take up wear. We have found this a very simple and smooth method of mounting. The hard rubber block is of course bolted to the front panel so that the disc can be adjusted from the front of the set.

A rough frequency adjustment can be made, once the lechers are cut approximately to length, by bending the tiny tubular grid condenser so that its pigtail leads either add to or cancel out portion of the lechers — electrically that is. Quite a wide variation is possible this way, so that the best band coverage is possible with the main control.

Some amateurs use a vane sweeping across the lechers for tuning, even moving between them. Electrically the efficiency of these ideas is about the same. Tuning condensers are rather hard to use mechanically, although it can be done

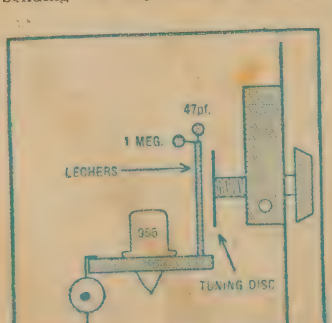
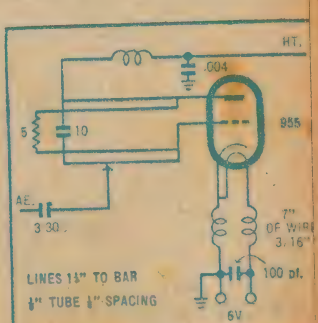


Diagram showing physical arrangement of tuning mechanism. Lechers are 1¼in long of 1/8in tubing spaced 1/8in.



Detector circuit showing aerial coupling connection tapped to the grid side of the lechers.

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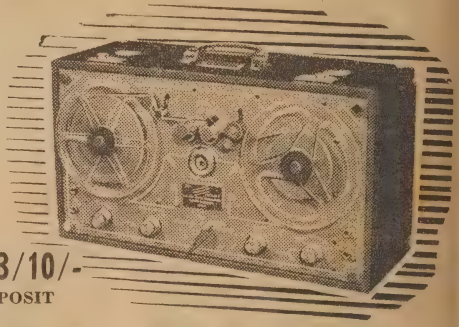
DEPOSIT

THE EXCLUSIVE MAGICTAPE RECORDER

A high fidelity instrument for home recording on tape with all the wonderful advantages of tape described above. Records permanently radio programmes, dance bands, voices, with magnificent concert tone from radio or life. Recordings may be erased and tape used again; easy to use and edit. Full price is £121/7/9 ,easy terms.



£43/10/-
DEPOSIT

Teletape Portable Recorder

For an easy portable, high-fidelity, easy-to-use tape recorder, the Teletape remains Australia's outstanding value! This handsome case is simple to carry to the homes of your friends, to your office, or anywhere you would like to record or play back your recordings. The Teletape records a full half-hour at a time, with amazing faithfulness and no background noises of any kind. It will record speech, singing and music, equally clearly from life, radio or the gramophone. You can play back immediately, or any number of times. You can erase a recording and use the tape again. **Price £129/10/-.**

Plenty of reels of half-hour recording tape **45/-**

Build your own tape recording outfits, with our tape decks . . . **£69/10/-**

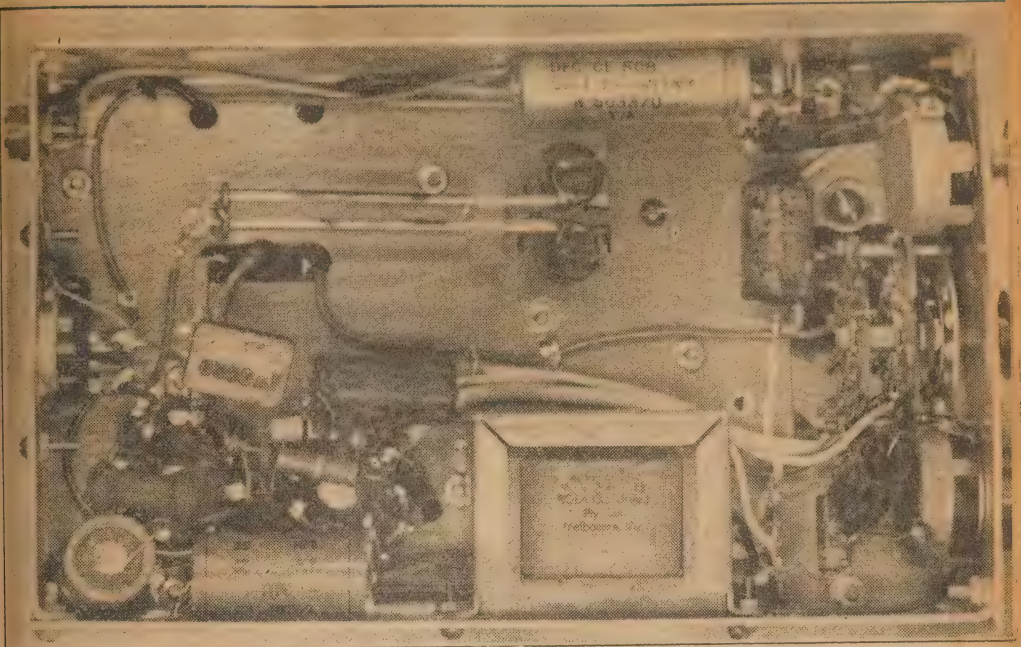
Coming soon: new release of lightweight portable tape-recording decks, about . . . **£45**

Tape-recording motors at **£4/12/6 & £5/17/6**

MAGNETIC SOUND INDUSTRIES (AUST.)

SYDNEY RADIO THEATRE, 1st Floor, 590 George St., Sydney.

Open Saturday mornings. **Phone M3652. OPP. REGENT**



This underchassis view shows cathode lechers at the top, audio choke at bottom, audio valve sockets at left—switches &c. at right.

selecting a very small, split-stator type.

Aerial coupling is something of a headache at this frequency. The method used must be equally suitable for transmitting and receiving, and if possible, for a change-over switch.

We used 300 ohm line for several reasons. Firstly, by using a double-wafer switch, and straddling the 300 ohm input across a section on each wafer, a roughly correct spacing can be maintained to switch through from transmitter to receiver. We reduced the spacing between wafers by cutting away about one-third of the spacing washers. Connection to the transmitter aerial lechers was made by two open lines spaced to give about 300 ohms.

Coupling to the receiver is via the cathode choke made a little larger than normal — 2 turns ½ inch diameter. A single turn aerial coupling loop was close-coupled to this coil and fed from the change-over switch.

OTHER METHODS

Many amateurs use a length of tubing in the cathode circuit carrying one of the filament leads something like one-half the transmitter cathode circuit, and tap the aerial connection part way along the tubing. This is really an equivalent circuit to our own but calls for an unbalanced connection. Our method avoids the use of trombone connections, etc. and also allows an aerial switching which would be unsuitable for the co-axial cable required for the trombone circuit. There is no easy way of switching co-axial

(Continued on Page 79)

A close-up showing detector valve at left, and transmitting valves at right. Transmitting lechers are 1¾in long and used with shorting bar.

Goldring

FIRST IN AUSTRALIA TO OFFER

Complete Long Playing

MICROGROOVE EQUIPMENT

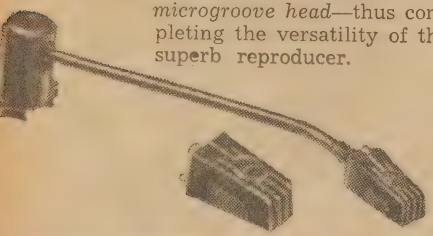
• THE PICKUPS

Goldring Pickups (high-fidelity) have been proved in the markets of the world . . . now bring microgroove pleasure to Australian music-lovers.

TWO FAMOUS MODELS THAT HAVE SET THE STANDARD OF PICKUP DESIGN

1. "Headmaster" Pickup

Hyper-fidelity, with interchangeable heads. Introducing the interchangeable head system to Australia, the Goldring "Headmaster" has met with universal acclaim. Now available is the *microgroove head*—thus completing the versatility of this superb reproducer.



TYPE OF RECORD	STYLUS TIP SIZE	COLOUR CODE	RETAIL PRICE
WIDE RANGE	.0020"	Red	35/-
STANDARD	.0025"	Green	35/-
OLD TYPE	.0035"	Orange	35/-
LONG-PLAYING	.0010"	Yellow	47/6
ARM - 12"			35/-

IF UNABLE TO OBTAIN FROM YOUR RETAILER OR WHOLESALER, CONTACT

GOLDRING ENGINEERING

(AUSTRALASIA) PTY. LTD.

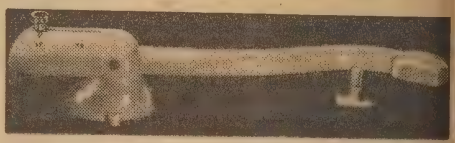
57 H.E. Area, St., Marys, N.S.W.

to whom all technical correspondence may be addressed.

South Australian Agents: Farley and Fahy, 77-79 Wright St., Adelaide.

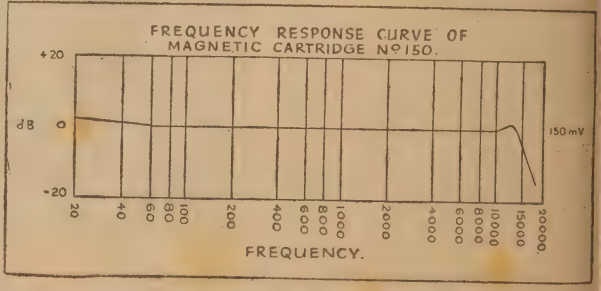
2. Three-way Pickup

Goldring's 3-way pickup provides a very neat solution to the problem of changing from Standard to L.P. records. In this design, the stylus becomes the armature. Changing from Standard to L.P. is achieved by changing the stylus and by weight adjustment on the arm. **Retail £7/10/-**



SPECIFICATION

Output (at 3.16 cms/sec. RMS velocity) .. 150 millivolts
Frequency range .. .. 30-16,000 cps.
Stylus Pressure 78 r.p.m. .. .. 14 grams
Stylus Pressure 33 1-3, 45 r.p.m. .. .. 7 grams
Coil Impedance (at 1000 cps) .. .. 3000 ohms
Coil Resistance .. .. 2000 ohms
Optimum Load .. .. 50,000 ohms



FROM THE SERVICEMAN WHO TELLS

I've had a lot of inquiries lately about the type of test gear needed to start a radio service business. It's far too large a subject to be handled in one article, so I have decided to spread it over the next few months, at the same time detailing the more interesting service problems as usual.

[OST of the inquirers have been those who have a job in some ıase of the radio industry, and are ›rhaps taking a course of study. ıey want to undertake some spare ne servicing, both as a source of ıcome and to gain experience ‹ainst the time when they can open ‹ir own service shop.

Since the financial outlay usually ıs to be considered carefully, the ıew chum" is often a little con-ısed as to what will represent the ‹st investment of his limited capital. he can only buy one instrument a time, what is the best to buy rst, and in what order should he ›nsider additional items?

Should he build or buy his equip-ıent, and what represents the best ›mpromise between cost and per-›rmance in any one particular item?

These and a dozen other ques-ıons crop up every time the pur-hase of a piece of equipment is con-emplated and there is so much to e said for and against all aspects ıat it is impossible to lay down hard nd fast rules. The best I can do s present the facts as I see them in he light of experience and hope that hey will help you to make your own ıecisions.

MPORTANT MULTIMETER

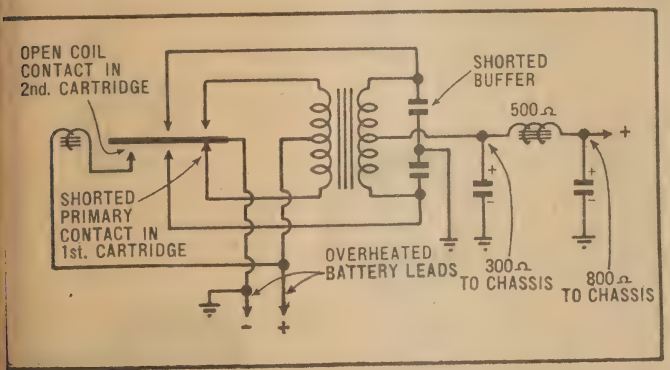
While there have been countless rguments on the relative merits of arious pieces of test gear, I don't hink anyone will deny that the ıultimeter is first on the list. The arge majority of receiver faults can e found with this instrument and, f it is all you have to work with for while, it will probably be all to he good, for it will teach you to ıake the best possible use of it.

Admittedly this may slow down ›ur work a little and, in fact, if you tried to run a full-time business on this basis you'd probably go broke. However, spare-time work is not so critical and the additional time can fairly be charged to experience.

Now what kind of multimeter should you buy?

First point which is often raised is whether it should be AC/DC or DC only. There does not seem much doubt that the slight extra cost of the AC ranges is well worth while, as plenty of faults occur on the AC side of the circuit. Even in country areas the prevalence of vibrator sets calls for this feature.

In addition to these more obvious uses it must be remembered that the AC ranges form the basis of the output meter and, while you may not need this immediately, you certainly will when you add an oscillator to your kit.



Two faulty cartridges and a shorted buffer condenser caused a succession of troubles in this PA vibrator supply, and the absence of a fuse caused unnecessary damage.

How many ranges should it have?

If an instrument is not to become unduly complex (and costly) it is desirable to restrict the main selector to one switch, and this in turn means no more than twelve ranges, as this is the maximum number of positions on a commercial switch.

The three characteristics to be read are voltage, current, and resistance, and four ranges of each is a very popular and satisfactory arrangement. Sometimes only an eleven-position switch is used and the resistance ranges may be reduced to three but if these are carefully selected they will still provide adequate coverage for all but exceptional cases.

The voltage and current ranges are fairly well standardised at 10, 50, 250 and 1000 volts AC and DC; and 1, 10, 50 and 250 mA DC. There does not appear to be much point in going beyond these, as they are quite adequate for receiver service. More ranges only increase the complexity and cost without contributing anything to your ability to service sets.

I stress this point because it is possible to buy instruments having many more ranges than those mentioned, but these are intended mainly for laboratory use or other specialised applications, where a much wider range is desirable. In such cases the additional cost is of little importance.

At the present time an instrument with 11 or 12 ranges would cost between £13 and £14. This can be regarded as a sound investment since, with ordinary care, it should give many years of hard and continuous service.

Lower priced, ready-made instruments are available and, while the quality is usually maintained, the ranges will be restricted either by the omission of AC ranges or some of the resistance ranges, or both. Most fellows feel that, having gone so far, they may as well spend a few pounds extra and have the additional ranges. In this regard it would seem wise to avoid the lower priced varieties, as they are barely adequate. However, they are better than nothing if finance is really a problem.

RELATIVE MERITS

Another point to be considered is the relative merits of the multimeter as just discussed and those of the combined valve tester and multimeter. These latter instruments are extremely versatile, providing the normal multimeter ranges with perhaps some additions in the resistance section, plus valve testing facilities and such additional features as condenser leakage tests, capacity tests and electrolytic checks.

There is no doubt that one of these instruments is an ideal piece of equipment for a serviceman but there is some doubt as to whether it is the best for your first purchase. In the first place, there is the outlay to be considered. There won't be much change out of £40 for one of these, and this may mean putting off the purchase of any other instrument for many months.

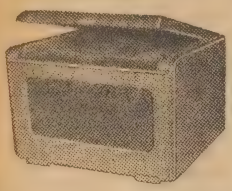
It is often thought that if a multimeter is purchased first and a combined unit later the former will be rendered obsolete or unnecessary, but this is seldom so. By the time you are ready to tackle full-time servicing you will find that there is a place for both on your bench.

PORTABLE

Not only is it often necessary to measure more than one characteristic at a time, but the smaller instrument is very valuable when a job must be done away from the shop, for the combined instrument will most likely be portable in name only.

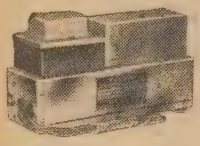
Homecrafts PTY. LTD.

★ BARGAINS ★ FOR THE RADIO ENTHUSIAST



Radiogram Cabinets. Walnut piano finish radiogram cabinet, suitable for 4 or 5 valve table radiogram. £7/19/6.

Disposal Bargain Telephones. With 10 mile range. As illustrated. Cut to only 25/-. Batteries 5/6 extra.



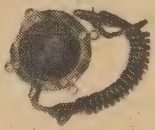
English Inverters. Valradio 32 volt D.C. input, 240 volt, 50 cycle output at 100 watts. £28/17/-. Also available:—6 or 12 volt to 240 volt at 100 watts. Price, £42/18/8.

Foundation Kit. Bargain! A few more available! Bakelite Cabinet, chassis, front mounting plate and dial assembly. As illustrated. Only 45/-.

12 Volt Non-Synchronous 4 Pin Vibrators, cut to only 12/11.

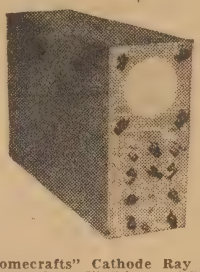
Home Broadcaster Microphones. Will work with any ordinary radio. Adds fun to a party. Cut to only 7/11.

Turning Head Torches. Focusing turning head torches, all-chrome finish, with Belt or Pocket Clip. As illustrated, 18/6.

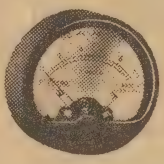


English 104 Crystal Mikes. 104 crystal microphone with high fidelity crystal. As illustrated. Price, £5/19/6.

BARGAIN TUNING CONDENSERS
Tuning Condensers. Two-gang, reduced to 9/11. Three-gang reduced to 12/11.



"Homecrafts" Cathode Ray Oscillograph. * 5" tube, * AC/DC Amplifier, * High sensitivity, * Wide frequency range. Price, as illustrated, £78/-/-, plus 8 1-3 per cent sales tax. (Terms available).



Disposal Bargain. 3" Scale FERRANTI Moving Coil, 0-6000 volt Meters. Only 32/6.

EIMAC Transmitting Tubes.

*	Type 35T	£3/19/-
*	" 35TG	£4/12/6
*	" KY21	£5/17/-
*	" RX21	£4/9/-

Streamlined Steel Speaker Boxes. As illustrated, with brown crackle finish. Suitable for Speakers up to 8". Price, 45/-.

Brand New 6K7G Valves. Loose base only. Cut to 8/11, plus 9d packing charge.

Plessy Singe Record Players. Automatically places Pickup on Record, also has Automatic Stop. Models available with magnetic pickup, £8/15/-, with Acos Crystal Pickup, £9/13/2. Decca HI/FI Lightweight Pickup, £12/10/-.

★ SPECIAL SNAP BARGAINS

SPST Toggle Switches, only **1/3** each. 4 valve steel chassis, only **1/-** each. Brand new latest type Collaro High Fidelity Pickups, **29/11.** Disposal 2000 ohm headphones, only **19/11.** Leatherette covered portable Cabinett, **9/11** each. Morse keys; Small size, **1/-.** Large size, **2/-.** Crown STI full vision D/W Dials, only **9/11.**

Country and Interstate Clients please add freight or postage.

290 LONSDALE STREET, MELBOURNE : : Central 4311

This last fact is also a strong point a favor of buying the smaller instrument first, as it is unlikely that ou will have your own transport at his stage and it is often easier to ake your gear to the set and do the ob on the spot.

This means that your meter, plus ools and spares, will all have to be ccommodated in a reasonable size ase, one that will not be too difficult to handle in public transport. his is particularly important if it ranspires that the set has to be rought back to your workshop after ll.

All this discussion seems to set the erviceman's multimeter at one having 12 basic ranges, plus AC and output volts, and all housed in a case bout eight or nine inches square and bout four inches deep. This size nakes a nice compromise between ase of carrying and a reasonable ized meter, the four-inch rectangular types having clear open scales vhich are easy to read.

Now comes the question of whether o buy such an instrument ready-nade, or buy the various bits and nake it yourself.

There is something to be said for oth schemes and much depends on our individual circumstances. If ou decide to build your own you vill be able to save a few pounds on he deal, but this saving is really nly worthwhile if you can spare the ime, not only to do the job itself, ut also to track down those few lusive bits and pieces which always eems to be "in short supply at the noment."

EXPERIENCE

In addition to the financial saving, here is the very real value of the experience gained in work of this kind and, with some knowledge of he "innards," one is usually more onfident about tackling a minor repair, should the occasion arise.

On the other hand, one must guard gainst test gear which looks "home nade," particularly in the case of he multimeter, as this will find its way into your customers' homes more than any other. Nothing creates a worse impression than test equipment which does not look the part.

Some may think that this is being unnecessarily "fussy" but, believe me, it pays dividends. After all, the hardware dealer uses a window to display his wares and, if he is a good businessman, he takes care to see that what he has to sell is displayed to the best possible advantage. You also have something to sell—service —and it's up to you to display this to the best advantage. The fact that it is an intangible thing undoubtedly makes it harder, but none the less necessary.

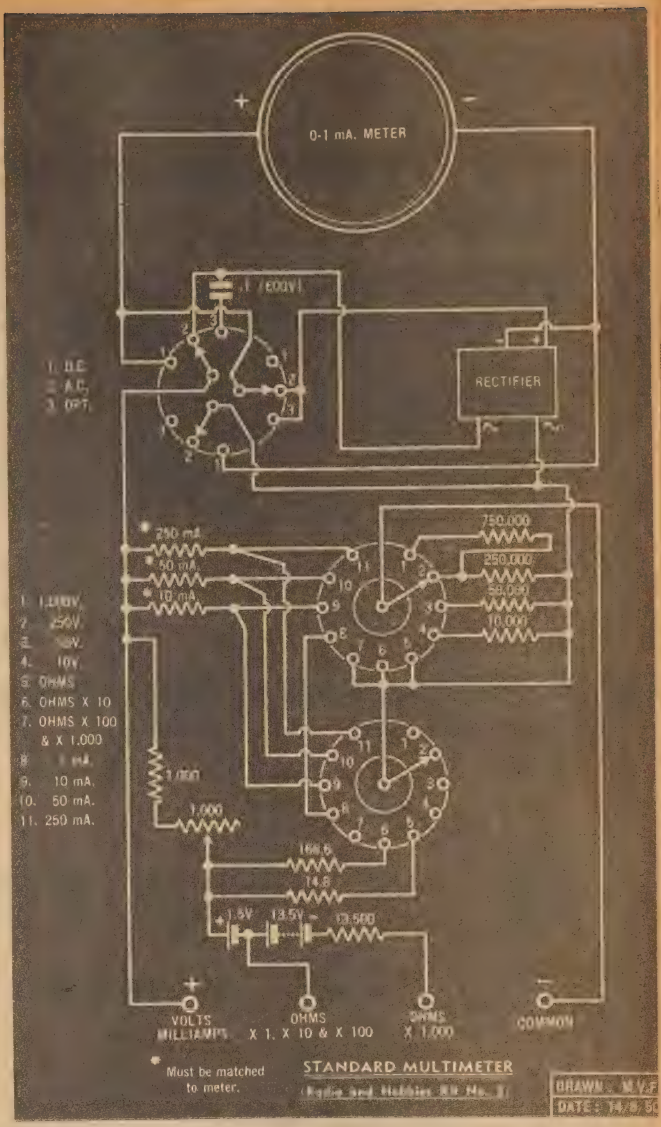
There is no real reason why your multimeter should not finish up looking like a commercial model, the most important thing being the provision of a suitably engraved panel. There are several ways in which this can be done, such as having your own panel engraved after you have decided on the layout or by purchasing such a panel ready-made. I believe these are available now.

COMPLETE KIT

Another alternative, which solves the panel problem as well as the supply of all the other items, is to buy a complete kit of parts as marketed by some of our meter firms and intended for home construction. In any case, these firms are usually the best source of supply for most of your needs in this regard, particularly for such items as shunts, multipliers, &c.

To help you get some idea of what is involved in making your own, I have asked the Editor to publish the circuit diagram of their most recent version of a multimeter and, if any further details are required, I have no doubt they can be supplied through the usual channels.

On the other hand, if your time is limited or your shopping facilities restricted, and you can afford the extra outlay, it may be more convenient to buy a ready-made instrument. Apart from the immediate convenience, you will have the advantage of the professional appearance and, in many cases, improved circuitry which is not normally available to the home builder.



This applies particularly to the "ohms" section, which can be so designed as to provide a very much higher degree of accuracy over a wide range of battery voltage and is achieved by using a shunt system of zero adjustment instead of the more usual series arrangement.

Such instruments can be recognised by reference to the centre value of the ohms range, which will be 15 (or a multiple) for the series system, and 11 or thereabouts for the shunt.

And that, I hope, is a fair analysis of the multimeter in its various forms and its place on the service bench. The final selection is up to you.

Getting back to more practical matters I find that my most interesting case this month concerns a vibrator type PA system. It had failed com-

letely and the owner drew my attention to the battery leads, which howed every sign of being badly verheated.

I suggested that the vibrator had robably failed, as a sticky primary ontact will cause symptoms of this ature, but the owner said he didn't hink so. He had fitted another cartidge immediately the set failed but still would not function.

This implied that perhaps the ibrator had stuck and burnt out ome part of the primary circuit, hich would account for the failure f the new vibrator. Alternatively, here might have been a direct short n the primary circuit, including ossibly the filament network.

In view of this last possibility, I ecided to check the wiring very arefully before applying any power, s it is all too easy to overload fila- ents when some part of a series arallel circuit runs amok.

NO SHORTS

However, a careful check revealed o obvious shorts, the filament net- ork being intact and the battery eads still continuous, although their nsulation had been well and truly ooked. I replaced these, went over he circuit again, and then rather ingerly applied some power.

There was only a mild spark when he clip touched the battery, and here did not appear to be any sign f distress in the leads. A voltmeter heck of the filament circuit con- irmed that all was correct here, nd as the unit did not look like amaging itself, I felt I could pro- eed with further investigations at a ore leisurely pace.

But although everything appeared afe enough, it was quite obvious hat the unit was still dead and qually obvious that the vibrator was ot vibrating. Forgetting for the oment that the owner had said it as a second one, and more from orce of habit than anything else, I ave it a smart tap—at which it gave orth its characteristic hum and the peaker showed signs of life.

I switched off for a moment, then n again, but the vibrator refused to tart without some outside help.

It now seemed fairly certain that ny original diagnosis of sticky vibra- or contacts had been correct, but hat both the owner and myself had een deceived by the fitting of an- ther one which was a poor starter. ts past history was apparently un- ertain.

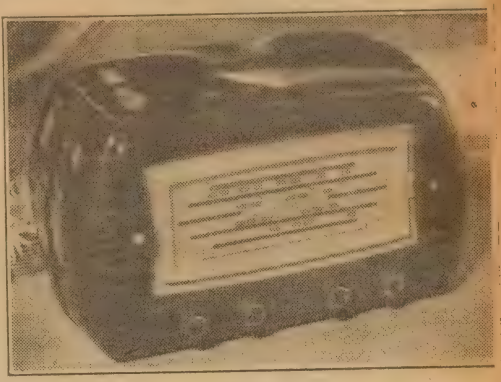
BURNT CONTACTS

Just to be sure on this point I hecked the old cartridge with the hmmeter and found one of the rimary contacts showing continuity o the reed. On opening it I found hese two contacts badly blackened nd firmly stuck and, although I was ble to free them, there seemed little oint in trying to effect a repair.

Repairs are sometimes possible here contacts are only slightly pit- ed and can be "dressed" with a mag- etо file, or merely need to be cor- ectly spaced. In this case, however, he excessive current had heated oth the contacts and springs to the oint where the latter had lost most f their original temper. When this appens it is useless trying to ad- ust the spacing of the contacts, as he most careful adjustments are ost after a few minutes' running

TRADE NEWS—A NEW RADIOLA

The new "Champion" range of receivers announced recently by AWA includes "a Radiola for every occasion." It includes a full range of AC models, battery, accumulator, 32-volt models and a car receiver.



PRIDE of the range is the "Radiolagram," model 805GZ, which is a nine valve mains operated deluxe radiogram. It features record changer, all-wave reception with bandspread, tuning indicator and separate bass and treble controls.

The receiver illustrated on the right is the Champion senior 4, which is a four-valve dual-wave receiver, featuring high gain valves and reflexed circuit. Valve lineup is X61M, 6AR7-GT, N78 and 6X5-GT.

The speaker is a 6½ inch AWA unit and the audio design provides for negative feedback and automatic bass boost.

A range of cabinet colors is provided, including walnut, burgundy and ivory.

The second cartridge was a different matter, probably only requiring a slight adjustment to make it a reliable starter. Accordingly I opened this one also, and by holding it up to the light I could see that there was a minute gap between the reed and the coil contact.

To fix this was only a few moments work, merely requiring that the locknut be slackened and the contact screw given about half a turn. Upon the application of voltage it started immediately, but to be on the safe side I continued to switch it off and on several times, making sure that the reed was allowed to come to rest each time. When this failed to reveal any sluggishness I felt confident in passing it as OK.

Occasionally, even a new cartridge will exhibit this fault and, as in this case, it can cause some very misleading results.

Well, that's another one fixed, I thought, as I prepared to replace it in its cabinet, but alas, it was not to be.

I had left it running on the bench while I applied a little "spit and polish" to the case, and I suddenly realised that all was not well. The note of the vibrator had changed and there was a hum level which had not been there before. A finger on the input terminal indicated that the sensitivity had dropped and a quick check with the voltmeter showed a much reduced HT voltage. Now what? I thought, having visions of another vibrator giving up the ghost.

ELUSIVE 300!

However, the ohmmeter showed no signs of sticky contacts, so I turned my attention to the circuit proper. From the HT line to chassis measured only 800-odd ohms, and moving to the first electrolytic reduced this to about 300. The electrolytic looked like the culprit and I disconnected it, but, no—there was still 300 ohms to chassis!

At this stage I felt the need to refresh my memory on the finer points of vibrator circuits, and referred to a service manual for a typical example. It's remarkable how such a circuit can help when one is a little rusty, and almost as soon as I saw it I knew where the trouble was—the buffer condensers.

A short in one of these would have just the effect on performance which I had noticed, being, in fact, a short across one half of the transformer secondary. It would also account for the 300 ohms from HT to chassis, this being the resistance in the transformer secondary.

VOLTAGE RATING

This indeed proved to be the case and, while I was replacing the faulty one, it occurred to me that perhaps its voltage rating had been a little on the lean side. I therefore selected a new one with a higher rating and decided to change the other one at the same time. After all, the additional cost was only a few pence and, if it provided some insurance against a further breakdown, it was well worthwhile.

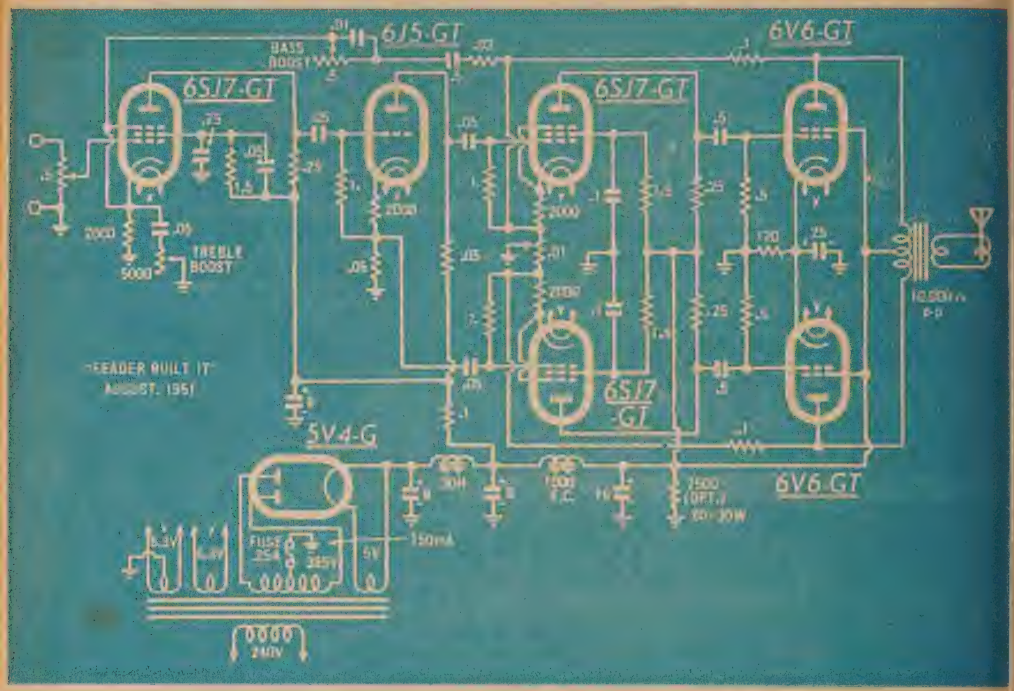
Finally, when the rest of the gear had been stowed in the carrying-case, I cut the positive battery lead and fitted a fuse-holder—a precaution which should have been taken when the unit was first built.

Many people, including radio enthusiasts, fail to appreciate the amount of power which is stored in an accumulator, or that it can all be discharged very rapidly when the path is provided. When a short occurs a great deal of damage can be done while the operator is fumbling for the switch!

A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

ANOTHER APPROACH TO IMPROVED AUDIO RESPONSE



Here is another angle on audio amplifier design which may prove of interest to many audio enthusiasts. The four valves in the output stage act as two valves insofar as stage gain and drive requirements are concerned, and this, our contributor points out, results in some special features.

THE details of this amplifier come from Mr. J. Miller of 21 Sutherland St., Lane Cove, Sydney, NSW who is very keen about its performance.

The circuit diagram shows push-pull 6V6-GT's driven by push-pull 6SJ7-GT's. A feedback loop is taken from each 6V6-GT plate to the respective cathode circuit of the 6SJ7-GT's. The degree of feedback is such that the 6SJ7-GT's contribute little or no gain.

Mr. Miller points out that this reduces the effective plate resistance of the 6V6-GT's from 52,000 ohms each to something like 30 ohms each and the output distortion to less than .05 pc total.

The two push-pull stages must be considered as a composite group so that the figures for drive requirements and overall gain of a conventional 6V6-GT stage must now be applied to the grids of the push-pull 6SJ7-GT's. Consequently, a pick-up capable of about .5 volt RMS output would be required at the input terminals to drive the amplifier to Mr. Miller's quoted output of 8.5 watts.

Between the two push-pull stages, the degree of feedback is virtually constant at all frequencies. There is, however, an additional feedback loop from the cathode of the "upper" 6SJ7-GT to the screen of the input stage. This feedback is effective in the middle and upper register only so that there is an apparent boost of the bass frequencies. The point at which this effect commences to operate is open to adjustment by the "bass boost" potentiometer in th feedback loop.

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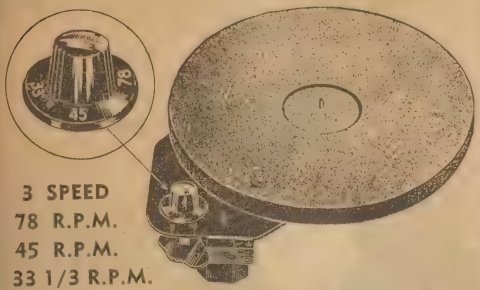

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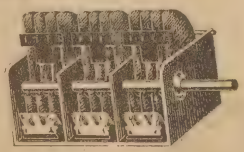

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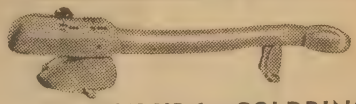

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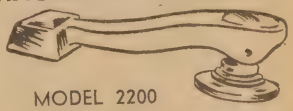

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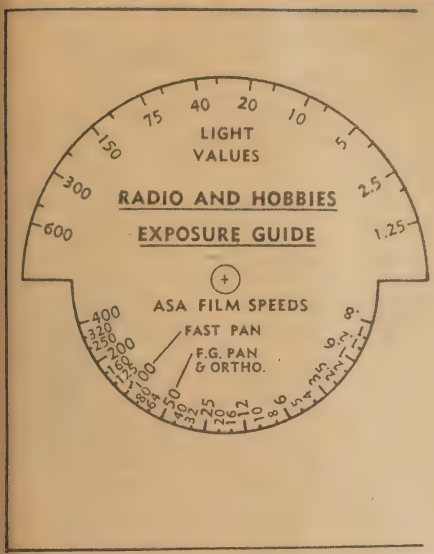

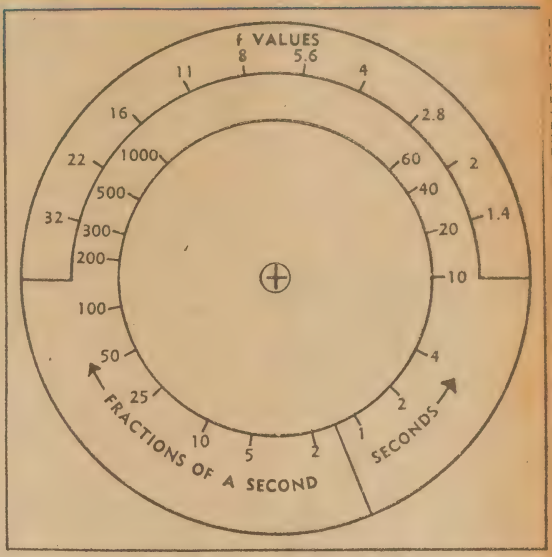

Cut out and assembled as described in the article, these diagrams make an efficient exposure calculator. The "Fast Pan" and "F.G. Pan & Ortho." markings are approximate only, for exact figures refer to film speedtable.

"What exposure will I give?" is probably the most frequent question asked by the beginner, to whom the array of shutter speeds, lens stops and film speeds only means greater confusion. In this article we discuss the factors affecting exposure and describe a simple calculator which will give you the correct exposure in a few seconds.

THE first step in the production of a photograph is the exposure of the negative. On the correctness of this exposure depends the quality of the final print, or even the chances of getting a print at all. In some cases the error is such that the print is of very poor quality, lacking in contrast and deficient in detail in the shadows. Greater errors result in so little negative detail that it must be regarded as a complete failure.

In many cases, where equipment is limited and conditions are poor, the choice is between a poorly exposed negative, which may be usable, or none at all and, in these circumstances, one is justified in "having a shot at it." If, on the other hand, the conditions are so bad that there is no chance of success, it is only sheer waste to try.

RECOGNISING CONDITIONS

To recognise these conditions is the problem which faces the beginner and it is the purpose of this article to discuss the factors involved, so that you may be in a position to make a reasonably accurate estimate of what is the correct exposure over a wide range of conditions.

The two extreme conditions which must be avoided are under and over-exposure and, of the two, under-exposure is by far the most common. Fortunately, once the minimum safe exposure has been reached, there needs to be a considerable increase before the region of over-exposure is approached. This latitude of modern black and white emulsions means that any estimate of exposure which is approximately correct will result in a satisfactory negative, particularly if the error is in the direction of too much, rather than too little.

A given exposure occurs when a certain value of light is allowed to act on an emulsion for a certain time. If the strength of the light is increased, the time may be decreased and the exposure will be the same. Whether such an exposure is adequate depends upon the sensitivity of the emulsion, so that there are three major factors affecting exposure:—strength of light, time, and emulsion sensitivity.

Time and emulsion sensitivity can be given specific values, but the amount of light reaching the film is dependent on so many factors that, at the best, it is usually little more than a reasonably accurate estimate.

The light passed by the camera lens is one factor, but this may be calculated from the size of the lens opening ("f" value), the real snag being the light actually illuminating the scene.

The fact that our eyes adjust themselves for extreme values of light does not help from a photographic point of view, valuable though this characteristic may be in other ways. Our eyes make this adjustment so efficiently that we are only aware of it when the change is extreme and rapid, otherwise we see as well indoors or out, by daylight or lamplight, even though the difference in light values may be hundreds of times. Note that again — "hundreds of times."

CAMERA ADJUSTMENTS

Since the camera must be adjusted to cope with these changes it becomes necessary to establish a series of light values which can be recognised by virtue of the conditions affecting them, rather than by trying to judge how bright the light appears to the eye.

Assuming that we can assign a numerical value to all the factors mentioned, we are then faced with the problem of balancing one against the other to arrive at an exposure value. The process is likely to call for some mental gymnastics, unless we enlist the aid of some form of calculator, and this is the idea behind the device shown at the beginning of the article.

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gained some idea of the meaning of ens stop markings from last month's rticle, and will recognise the sys- em on the calculator as that adopted in English-speaking countries. To avoid confusion, we have deliberately avoided any other markings so that, n every case, the markings shown represent one full stop value. Where continental markings are encount- ered it will not be difficult to inter- polate their position if necessary, but n most cases the difference is neg- ligible.

The selection of shutter mark- ngs presented something of a prob- em, as there are many different systems" and a very large number of odd values. It was clearly im- possible to include all these, but hose finally selected seem to be the most popular and are so spaced as o give adequate coverage. Inter- mediate values may be selected with- out difficulty, and having quite sufficient accuracy.

FILM SPEED

It may seem rather surprising that there has ever been any difficulty in establishing a suitable system of film speed ratings, but the fact re- mains that it is only recently that any progress seems to have been made.

Various systems have appeared in the past but none have ever been completely accepted by all sections of the trade, who apparently feared that comparisons would show up one or other of their products to a dis- advantage. Thus a recent publication lists no fewer than nine different sys- tems and this is not the full story, for there are many small variations of the major systems quoted. In this list we have General Electric, Wes- ton, American Scheiner, European Scheiner, Din, and three versions of H. and D.

During the recent war, Service chiefs demanded some order out of the chaos, and the American Stan- dards Association produced an im- partial numbering system which has since been adopted by a number of meter manufacturers, and given rise to the use of "ASA numbers."

SIMPLE CALCULATOR

This is the system which we have chosen for our calculator, and we are including a table of speed num- bers for popular films on the Aus- tralian market. You will note that each third figure has been given a prominent marking and bolder type, which is to emphasise that the differ- ence between these values is equal to one standard stop number of the lens marking system. Thus an increase in sensitivity from 50 to 100 means that the same negative exposure may be obtained with one stop smaller, or with half the exposure time.

As already mentioned, the selection of light values presents the greatest problem. The figures shown on the calculator have been taken from the scale of a light sensitive meter and this has been used to collect data on daylight values over a wide range of weather conditions extending over many months. This data has been made into simple table form, and you should have no difficulty in selecting a value to suit prevailing conditions. The unmarked divisions represent values midway between those marked (450, 225, &c.), the scale being non-linear.

To use this table correctly it is important to be able to recognise the four light conditions shown. The first presents little difficulty, and is simply the full sunlight condition. The second is that when the sun is covered by light cloud, is still visible and is strong enough (but only just) to throw a shadow. The third is a dull condition, when there are no defined shadows, but the position of the sun can just be determined. The final condition is dull with no shadows and the position of the sun cannot be observed.

The figures shown are not ex- actly as recorded, but have been con- verted into round figures where only a few per cent is involved, and al- ways with the emphasis on increas- ing the exposure slightly.

To use the calculator, first select the light value for the prevailing conditions and time of the year. Locate this opposite the "f" value you wish to use, when the exposure time will be found opposite the speed rat- ing of the film you are using.

If you know beforehand the shut- ter speed you wish to use, locate this opposite the film speed, when the correct "f" value may be read oppo- site the appropriate light value. In this case changes in the prevailing light conditions may be allowed for by simply opening or closing the lens as indicated, and requires a minimum of time.

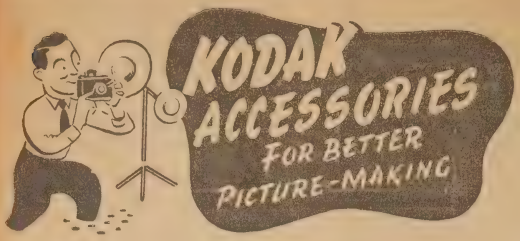
When using a box camera refer to the maker's instructions for details of the lens opening and shutter speed. If these are not available it is usually safe to assume 1/25 of a second at f11. Some models have two or three smaller stops as well and these will probably be f16 and 22.

Even when there are no adjust- ments, the calculator is useful to in- dicate whether the chances of suc- cess are reasonable. The scope of these simple cameras can be extend- ed considerably by the use of mod- ern fast films, and, if there is no means of reducing the exposure under bright conditions, it should still be within the latitude of the film.

LONGER EXPOSURES

The calculator also renders much more useful the "time" setting on these cameras, for it may often in- dicate that a picture is possible if an exposure of several seconds is permissible. If you can find a firm support for your camera and the subject is not likely to move, there is no reason why this exposure should not be given, resulting in a picture which would otherwise have been missed.

You will find that, at times, your film rating will be located between two shutter speeds and you may be a little uncertain which to choose. It is always safest in cases like this to choose the lower speed thus favoring



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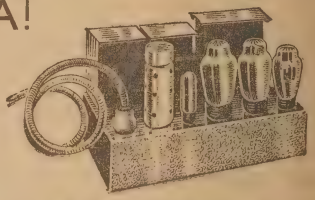

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ie greater exposure. If you are rying exposure by means of the ns opening it is quite practicable set this between two stop mark-gs, and this may be worthwhile if ou are striving for the greatest pos-ble depth of field and cannot toler-e a slower shutter speed. Other-ise set the diaphragm to the larger pening.

Don't wait until you are ready to ke a picture before consulting the lculator — your subject may not lways wait. Rather make it a prac-ce to have your camera set correct-whenever you are carrying it, and ake the necessary adjustments if ere is a permanent change in con-itions.

The effect of subject matter on xposure needs to be considered, but is not of as much importance as often claimed. The exposures re-ulting from the calculator are based n average subjects, that is, they ssume a certain amount of dark lothing and shadow areas in which etail should be retained.

SPECIAL CASE

Assuming that the exposure is orrect for this subject, what will appen when these dark areas are o longer present, as, for example, hen photographing players in light lothing on a tennis court? Should he exposure be decreased, and will ver exposure result if it is not?

The answer to this is that the xposure may be decreased if there s any advantage in so doing, but it s not essential to do so, and the egative will not be over exposed in he true sense of the term. Admitted-y it may be a little more dense than isual, but it will still be capable of iving a perfectly satisfactory print, ndistinguishable from that made rom the "correctly" exposed nega-ive.

Similar subjects would be beach cenes and shots taken on the water here one stop smaller can be used n most cases.

On the other hand, subjects of a dark nature may be given an in-crease in exposure and, in fact, this is often essential if maximum detail is to be preserved. Into this category come animals with dark coats or subjects with large shadow areas in which detail is required. One or two stops larger can safely be used in these cases.

MAKING THE CALCULATOR

To make up the calculator it will be necessary to paste the diagrams on a piece of card or similar support, then cut out and assemble. For those who do not care to cut their copy of Radio and Hobbies we are arrang-ing for diagrams to be printed on high quality art paper, and these will be available from our office or through the post, price 2/-. In addi-tion to saving your magazine, the art quality paper is better, both in appearance and reaction to pasting.

For the centre bearing several schemes suggest themselves. We do not recommend the use of the com-mon paper clip as they will damage the support in a short time. If mount-ed on card a 1-8in nut and bolt, with washers, will make quite a neat job. The surplus bolt may be trimmed with a hacksaw after assembly. Bet-ter protection will be afforded the card if an eyelet is mounted on each piece to act as a bearing against the bolt.

If the body of the calculator is mounted on thin plywood and the centre disc on card, they may be held together with a drawing pin. Another idea is to mount the body on 16-gauge aluminium and tap the centre hole to take a 1-8in bolt. In this case it would be advisable to use a cement of the acctate variety as used for model aircraft.

A press fastener of the type used for car covers and overalls provides an excellent bearing and holds the two pieces of card firmly in each section of the fastener. The only objection is that it is a little large and there is rather more separation between the cards than is desirable. A smaller type may overcome these difficulties, something along the lines of a glove fastener possibly being better.

No matter what is used care should be taken to eliminate rubbing on the card surfaces, and a few 1-8in brass washers will prolong the life of the calculator considerably.

To make the unit complete, paste the light table on the back and, as there will still be some space left a piece of writing paper may be in-cluded on which you can note the speed ratings of your favorite films.

The light values given will cover most outdoor conditions, but a few additional details may be helpful. The "open shade" condition is very popular, if for no other reason than that it relieves the subjects of the discomfort of brilliant sunlight. By open shade is meant out of direct sunlight, such as in the shadow of a wall, &c., but well lit by reflected light from a large area of sky, and with no suggestion of a roof. Under these conditions the light value will be about one-tenth of the full sun-light figure.

A subject 2ft 6in from a twin 40-watt fluorescent lamp should be al-lowed a light value of two and, in a glassed-in veranda facing south and

(Continued on Page 83)

LIGHT TABLE

	No Clouds	Hazy with Shadows	Dull Sun visible	Dull or Raining
Jan. — Feb. Oct. — Nov. — Dec.	600	300	150	75
March — April Aug. — Sept.	450	225	110	55
May — June July	300	150	75	40

These figures are for use between two hours after sunrise and two hours before sunset. For the first hour each side, halve the light value. For the second hour, divide by four. Pan emulsions only. For ortho, double exposure at least.

FILM SPEED TABLE

Film	ASA Speeds Daylight	Tungsten
KODAK		
Super XX Roll	100	80
Verichrome Roll	50	25
Super XX 35 mm	100	64
Panatomic X	25	16
Plus X	64	40
Kodachrome (Daylight)	10	-
ILFORD		
HP 3	120	80
FP 3	64	50
Selochrome	80	40
DUFAYCOLOR	10	-

576MC TRANS-RECEIVER

(Continued from Page 63)

ole which at the same time pre-
sves impedance continuity.

Other coupling methods use a wire
ped along the grid circuit via a
all variable capacitor. We have
und, however, that the cathode cir-
t is possibly the best for aerial
upling, providing the best com-
mise between coupling and ex-
sive circuit loading. At this fre-
ency, we must often use loose
upling to avoid pulling the valve
of oscillation.

Experiment with aerial coupling
probably the most critical and
portant adjustment to the whole
ipment. The difficulty in making
receiver really work is one big
son why, unless a favorable geo-
phical location is available, com-
nication is often limited to short
tances. On the other hand, a high-
n, well elevated aerial will work
nders by feeding a good signal
but to the receiver, thus compen-
ing for the difficulty in obtaining
lly high sensitivity.

A simple way to compare cathode
upling with coupling into the grid
rcuit is to run a hairpin loop, or
small two-turn coil, from the
itch so that is it spaced close to
e lecher lines. Experiment will
termine the best spacing, &c., for
adest signals. There is room on
e chassis to try out all kinds of
rial coupling, but we have found
at when properly adjusted, each
ethod works out very much the
me.

Perhaps the best method of all
ould be to duplicate the tuned
rial lechers for coupling into the
ceiver. Mechanically, however,
is isn't very easy, particularly as
e detector would probably be
illed out of oscillation before any-
ing like optimum coupling was
ached.

In achieving smooth regeneration,
xperiment with the actual sizes of
e RF chokes will often improve
atters. We did not find them par-
cularly critical within reason, but
hers have done so.

ETECTORS

We have found that marked dif-
rences are often noted in the be-
avior of detector valves. One of
ie best we have seen came quite
moothly into super-regeneration
ith only about 50 volts on the plate
very similar in fact to the valve's
ehavior on lower frequency bands.
is more likely, however, that
lthough the valve might come out
oscillation fairly smoothly it will
ommence with a slight plop. While
here is every reason to work on it
or smooth operation, it isn't easy
make it work perfectly. That
one reason why these simple re-
eivers are really suitable only for
omparatively short distances or
here there is definite line of sight.
When this happens, and high gain
erials are employed, it is surprising
ow strong signals can be.

This trans-receiver has not yet
een operated either with a high
erial or from a good location. Rising
round on all sides has been a handi-
ap. However, over several miles
o a nearby amateur, good signals
ave been exchanged. The modu-
ation depth appears to be adequate,
nd the transmitter is reasonably
table — probably assisted in this
regard by the tuned aerial coupling.

The presence of the switch in the aerial lead does not appear to prejudice results. Removing the aerial feedline from the switch and connecting it directly to the circuit made no difference to signal strength. It might be important to see that the wafers are clean and not bathed in dirty solder flux as often happens to switches from ex-disposals equipment.

Our aerial was a sixteen element array with eight radiators and eight reflectors. The feedline was ordinary 300 ohm ribbon. A better feedline would be the tubular 300 ohm cable obtainable at much higher price.

Next month we may be able to give some details on aerial construction.

AN article published in America claims to reveal the story of the Soviet MIG-15 jet fighters which have done so well in Korea.

It is claimed that the aircraft uses the Rolls-Royce Nene engine, to which most of its performance is attributed. It is claimed to fly at 646 mph at 16,000ft but US pilots in Korea say that it does better than this.

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30/- SHEET

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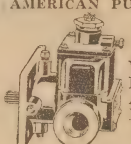
ROTARY AMERICAN PUMP

USED BY THE R.A.F.



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AT LAST! BRITISH MADE INTER-CHANGEABLE BLADE SURGICAL SCALPELS

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3 BLADES For The PRICE OF 1. Made from Finest Quality Steel.

Handle and 3 Blades 10/6. Extra Blades 1/- each.

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Make yourself a Battery Charger
6v 2 amp .. 24/6
6v 5 amp .. 32/6
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Transformers to suit above Rectifiers, 2 and 5 amp 6 volt only, 37/6.

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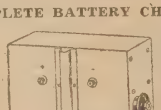
COMPLETE BATTERY CHARGER

Fitted with brand new English Selenium Rectifier



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Charges any battery from 2 to 6 volts at 5 amps £5/15/- complete.

BE EARLY FOR THESE WATER DRIVEN CAKE MIXERS, WORK OFF ANY WATER TAP

Brand New

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Will fit any sink.

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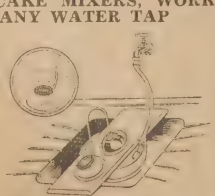

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DOUBLE SCALE VOLTMETER
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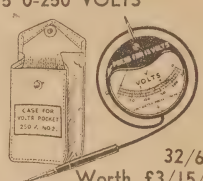

32/6

Worth £3/15/-

BRAND NEW CAR FIRE EXTINGUISHER

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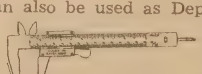
Made in U.S.A.
Worth £5/10/-
OUR PRICE £3/5/-

Ideal for Trucks or Caravans.

BRAND NEW ENGLISH VERNIER CALIPERS

Will measure inside and outside Can also be used as Depth Gauge.



25/-

Ideal for all types of engineering work. Measures in ins, and m/m. Can be carried in the pocket.

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Made in England. Optically ground Lenses.

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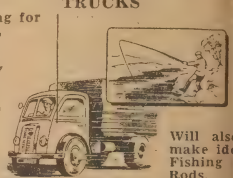
Ideal for instrument makers, watch-makers, tool makers, medical work, chemists, etc.

MOTORIST TROUBLE LIGHTS. — Work off any car battery. 12v. 4/6, 6v. 5/9.

STEEL ARMY TANK AERIAL RODS. WILL MAKE IDEAL RADIO AERIALS FOR CAR C TRUCKS

Too long for postage, advise nearest Railway Station.

Base to suit Aerial 8/6.

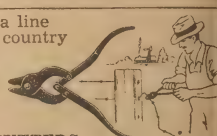


Will also make ide Fishing Rods.

12ft long. 3 sections. Each secti 4ft. 25/-. 8ft long, 2 sections 15

Here is a line for the country man.

Genuine Army Pattern.



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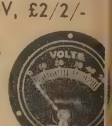
Builds up air pressure to 30lb at 1000 R.P.M. Develops up to 120lb per square in. of h draulic pressure, will pump 7½ g S.A.E. oil or other liquids per m ute. Useful for spraying, milki presses, oil burners, hydraulic s tems . . . . . £3/1.

Brand New American Weston Voltmeters 0-50V, £2/2/-

0-50 volts, 0-100 amps, combined, £3/10/-.



0-10 Weston Ampmeters 50/-.
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100 and 1 uses.

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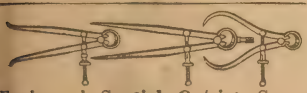

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Air Force Type. Blue Berets.

All Sizes. Ideal for Motor Cyclists, Motorists, Yachting, etc.

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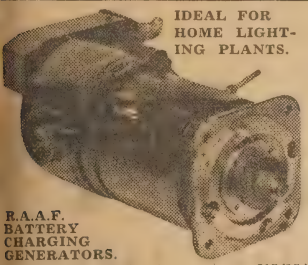

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Ideal for campers, cyclists, hikers.

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Leather Cloth Peak Caps, All colours and sizes. Guaranteed waterproof. 12/9 each.

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All sizes and waterproof. 52/6 pair.

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0-20 Voltmeters, 25/-
0-5 RF Ampmeter S 15/-

METEORS—BOMBS FROM BEYOND

(Continued from Page 13).

ythm and it is believed that these ers are more likely to blow up an any other star.

It appears that the pulsation of ese Cepheids is caused by a regular ntraction and expansion of the er and that the contraction causes ch an unimaginable pressure on e atoms inside the core that they e exploded. The result is a re- ise of almost pure energy.

When these explosions take place e results can be observed for one two weeks. The spectacle is rrifying. A vast flash of flame hich is thrown out from the star great rings at incredible speeds up to 600 or 700 miles a second.

So far away are many of these eat explosions that the light from em has only now reached us after avelling through space for millions years at 186,000 miles per second.

EFORE MAN

This means that the cataclysm must ve occurred long before man ap- ared on this earth and it is reason- le to suppose that, in these ex- osions, we are witnessing the dawn creation for it is thought that out the dust and energy flung from ese Novae new universes, new ns and solar systems are born.

May it not be that, in these island iverses, intelligent beings are even w watching the cataclysm which eceded the birth of our planet? Now, these explosions in the avens seem to be increasing from ar to year.

The years between 1850 and 1900 itnessed only three Novae but nce 1900 there have been outbreaks out every six years and up to date om 1900 the number of Novae wit- ssed has been many, many times ore than in the previous fifty ars.

A peculiarity of these phenomena their variety. Some burn with red light, some with a green light hilst others are of a dazzling white. It is fully recognised by astromoners at in this staggering activity there more to learn about the basic rces of the universe than in any- ing else, if we only knew how to about it.

Astronomers believe that the ex- osions give rise to the native ergy and native matter of creation d that the larger Novae have ef- cts on the stream of cosmic par- cles which bombard this earth in ncreasing streams.

NTENSE RADIATION

It is known for certain that these eat Novae send out radiation which as intense as the strong cosmic owers. It is also known that these smic showers can convert matter to energy, and life itself would be anged were it not for the filtering anket of the atmosphere.

In one of these explosions the par- cles sent out had a force of 100 illion volts. A force such as this n't travel throughout space with- ut affecting something. What with e shortage of electricity in New outh Wales it seems a dreadful aste of energy.

It seems that one of the results of ese cosmic disasters is the forma- on of what are called dwarf stars. hese appear to be matter con- olidated to such an extent that one warf star is known to have a weight of 200 tons per square inch. Some of these are believed to be so heavy that space is actually deformed and time is affected.

These dwarf stars glow with a dull white flame and it is believed there are black dwarfs even heavier.

What message is to be read in these great upheavals of nature is something upon which the great astronomers are continually pondering.

It is certain that in them is held the secret of creation. Maybe it is better that we never know for man cannot control his own devastating impulses and were he let loose upon the universe with the powers of nature at his command the result on present indications would be frightful in the extreme.

We are certain, however, to learn much more as scientists explore the upper atmosphere and outer space with the new instruments at their disposal. Even now it is talked about as a practical possibility that man may, in our time, personally explore the realms of outer space in space ships.

That may be a real fillip to commerce and industry for in these days of acute shortages the importation of a few boxes of butter, some bags of potatoes and a few dozen from Mars would be welcome in Sydney anyway!

LET'S BUY AN ARGUMENT

(Continued from Page 27)

and fall, even disappearing altogether in sympathy with the beat.

To a radio engineer, with AVC circuits at the back of his mind, it is only natural to expect that the insertion of a second strong signal into the "pass band" of a receiver will reduce the sensitivity to an original weaker signal. Or, again, a signal striking a response peak will reduce the intensity of another signal, even a stronger one, not so well placed in the pass band.

Actually, the AVC effect in a receiver (or an aural system) is a source of non-linearity and its possible interference with the audible signal is dependent on the time constant of the gain control circuit. What then is the time constant of the aural sense and does it affect the response to low frequency sounds in particular?

The admixture of radio and physiological terminology may have its amusing aspect but I'm not trying to be facetious. There is a very close association between the formulas and quantities involved in the various branches of physics.

THE RIGHT EXPOSURE

(Continued from Page 77)

east, about five in midsummer when 6ft from the glass.

As you become more experienced you can try experimental shots under less favorable conditions but, if you are to get the full benefit of these, it is important that you record the details carefully, and from the success or failure of the final print you can assess a light value for those particular conditions. By this means you can build up an extensive range of light values which will enable you to tackle almost any conditions.

SHORT WAVE NOTES BY RAY SIMPSON

RADIO MOSCOW'S ENGLISH BROADCASTS

There have always been programmes in English from Moscow, but in the past these have been confined to about half an hour at different times, and directed to various countries, depending on the particular time of the broadcast.

LATELY, however, there has been a big extension in these broadcasts and as an example of this, Moscow now transmits continuously in English for six hours forty minutes daily, directed to North America.

The times and frequencies for this particular session are as follows.—9.20 am to 10.30 am, 9.55 mc, 9.67 mc, 9.83 mc, 11.81 mc, 11.82 mc, 11.91 mc, 15.11 mc, 15.18 mc, 15.23 mc. From 10.30 am to 11.30 am they use 9.67mc, 11.82 mc, 15.11 mc, 15.18 mc, 15.23 mc. During the period 11.30 am to 2.0 pm they use 9.55 mc, 9.67 mc, 9.83 mc, 11.81 mc, 11.82 mc, 11.91 mc, 15.11 mc, 15.18 mc, 15.23 mc. In the final period from 2.0 pm to 4.0 pm they use, 11.82 mc, 15.11 mc, 15.18 mc, 15.23 mc and 17.81 mc.

There is also another program directed to the British Isles but at time of writing we do not know the times or the frequencies in use. No doubt any listeners who are interested will have already come across these transmissions.

RADIO RECORD VERIFIES

THE Sao Paulo Brazil station "Radio Record" has at last verified reception of their station, PRB9, on 9.605 mc. Their card shows an aerial view of Sao Paulo with this description, "Ten years ago its population was 1,336,261 — today it is 2,200,000. As it watches this tremendous development, Radio Record co-operates in it through a radio station which is truly "Sao Paulo's voice."

On the reverse side of the card are verification details and a list of their other stations, PRB20, 87.7 mc FM; PRB21, 6.055 mc; PRB22, 9.505 mc; PRB23, 15.135 mc. The address of these stations is, Radio Record SA, R. Quintino Bocaiuva 22, Sao Paulo, Brazil.

STATION ADDRESSES

PCJ.—Radio Nederland, PO Box 137, Hilversum, Netherlands.

MONTE CARLO.—Radio Monte Carlo, 16 Boulevarde Princesse Charlotte, Monte Carlo, Monaco.

SBO.—Radio Sweden, A/B Radiojanst, Stockholm 7, Sweden.

OQ2AC.—Radio College, BP, 296 Elisabethville, Belgian Congo.

SUX.—Egyptian State Broadcasting, Broadcasting House, Cairo, Egypt.

ZQP.—The Broadcasting Engineer, Broadcast House, PO Box 209, Lusaka, Northern Rhodesia.

TILS.—Radiodifusora Para Ti, Apartado 3, San Jose, Costa Rica.

HI2L.—La Voz del Tropico, Apartado 335, Ciudad Trujillo, Dominican Republic.

HRD2.—La Voz de Atlantida, Avenida 14 de Julio, La Ceiba, Honduras.

PRA8.—Radio Club de Pernambuco, Avenida Cruz Cabuga, 394, Recife, Brazil.

HC8GV.—Radio Luz, Apartado Postal 240, Calle Quito 418, Ambato, Ecuador.

RADIO EIREANN

OUR Victorian reader, Mr. Alexander Talbert, has asked us for any information we can give regarding Radio Eireann, as he heard a news broadcast from that station recently on 17.84 mc.

As readers will remember, we have often made reference to this station but it has mostly been to advise that certain sources state it to be off the air. The station itself does not clarify the position greatly as when they have stated that they were not operating on short waves we usually had a report from someone saying they had definitely been heard.

In one particular case this was from a listener who resided in Eire, so he should know!

According to the World Radio Handbook, which usually obtains its information direct from the stations concerned, Radio Eireann transmits on short waves from 4.30 am to 4.50 am on 17.84 mc and from 8.10 am to 8.30 am on 11.76 mc. These are the only times on the air, according to the handbook, though the station has a much more extended programme on medium wave. The station is actually assigned to the following frequencies, 6.19 mc, 9.595 mc, 11.74 mc, 15.114 mc and 17.84 mc, and the station is located at Athlone. Keep a lookout for this elusive Irishman and if you do manage to log the station a report can be sent to Radio Eireann, GPO, Dublin, Eire.

SHORT Wave Notes for the September issue are due on August 11. For the October issue they are due on Sept. 8. Please send them direct to Mr. Ray Simpson, 80 Wilga Street, Concord West, NSW.

CUBAN VERIFICATION

ONE of our Victorian readers, Mr. Alexander Talbert, kindly sent along a recent verification card which he received from COCQ, in Havana.

Their card is printed in brown, black and orange and shows call letters in black at top with a list of their various stations below. At the right is a view of the station building together with a microphone in front, and at the foot of their card their acknowledgment of report given in both Spanish and English. Altogether it is a very attractive card and an improvement on the one they used to use before the war. We have always been interested in this station since the days long before the war when it was one of the few Cubans heard at good strength. Actually they were very much louder in those days than they are now.

NEW STATION LOGGINGS

Call	Kc	Metres	Location	Time Heard
SOFIA	6070	49.42	Sofia, Bulgaria.	6.00 am
OLR	6095	49.22	Prague, Czechoslovakia.	5.00 am
TANGIER	7400	40.55	Tangier, Tangiers.	6.00 am
CR6RG	9190	32.65	Dondo, Angola.	5.00 am
SAIGON	9800	30.61	Saigon, Indo China.	9.00 pm

FLASHES FROM EVERYWHERE

SPAIN: For many years now the w known Madrid short wave station Ra Nacional de Espana has been assigned 9.369 mc and has actually used that ch nel continuously up till a few months Readers will remember we then repor hearing them on a new outlet in the metre band, 9.575 mc, where they mained for a week or so before retu ing to their old channel.

It has now been reported from the U that this station has now been he using 9.333 mc although still announc as 9.369. They have still been on th original frequency any time we have tened to them but it would be as well watch out for future changes.

INDO-CHINA: Here is another stat whose short wave stations do not seem be able to find a suitable channel. Ra France Asie is now using two outlets the 31-metre band or, more correctly, in the 30 and one in the 31. 9.524 seems to be permanent, but their ot channel has been measured on differ occasions as 9.75 mc, 9.752 mc, 9.8 mc 9.808 mc, although the station gives quency as 9.754 mc.

English programs are scheduled for 8 am to 8.45 am on 9.524 mc; 10.0 am 10.15 am, 11.30 am to 11.45 am on 9.8 8.0 pm to 8.15 pm on 11.83 mc and m night to 12.15 am on 11.78 mc. Has a one yet heard the French lessons fr this station which were due to commen in June?

MONACO: We do not seem to h very much about Radio Monte Carlo th days though it can still be heard in early morning and late afternoon on 6. mc. According to the Universalite th is a special program called "Allo Mo Carlo" broadcast from 7.30 pm to 8.30 on both 6.035 mc and 9.785 mc.

This program is in French and is p sented by Liliane Rose and Jaques Se nette every Sunday night. In this p gram listeners' requests by telephone recorded and later broadcast, toget with the gramophone record. We th this programme is also transmitted d ing our early morning, as we have he what seems to be the same thing one d at 5.30 am.

BULGARIA: Graham Hutchins' program is still giving some excell tips during their session each week whi incidentally, is currently being heard Sundays at 5.0 pm. From this source note that Sofia has moved from 7.57 to 6.07 mc, where they can be heard 6.0 am with program in English. A f ther English program can be logged 7.0 am.

There is a program for North Amer transmitted on 15.33 mc from 11.0 am 11.30 am and again from 2.0 pm to 2.15 p We have heard the first of these tra missions but strength was very poor a not nearly as good as the early morn session when it was on 7.67 mc. There a certain "sameness" in the news from these European stations.

MISCELLANEOUS: The Manila stat DZH7 has changed frequency to 9.75 to escape interference from Nanki Prague is reported to be using 6.095 for German transmission at 5.0 am; "F American Radio," in Tangier, was to m to 7.4 mc as from 1st July; The New Y station WABC is now using 9.59 mc can be heard in English till it leaves air at 5.0 pm; Radio New Zealand now be heard at excellent strength on 1 mc from 5.0 pm, with programmes dir ted to Australia; The Swiss short w stations will use their present calls frequencies until the end of August, will make some changes for the period September till 31st October; The Mail session from Ankara can be heard M days at 7.30 am.

THE HAM BANDS WITH BILL MOORE

The Remembrance Day contest for 1951 is again held on the week-end nearest to August 15th, the date that hostilities ceased in the last war. The Trophy, engraved with the names of all Australian Radio Amateurs who made the supreme sacrifice, is competed for by all State Divisions of the Wireless Institute of Australia.

EACH year a considerable number of amateurs pay tribute to the silent ers of 1939-45 by competing, and it is ticipated that the contest will again be ell supported.

At the recent Federal convention it as decided to vary the scoring section the rules in an endeavor to place the ger States on more even terms with e smaller States.

RULES

1. The contest will commence at 1800 EAST on 11th August and continue rough until 1759 hrs on 12th August. he period of operation of any station is mited to 24 consecutive hours.

2. The contest is open to all Australian nateurs but only members of the WIA e eligible for the awards.

3. The contest is an open event; CW, hone or a combination of both may be sed.

4. The contest is an interstate contest nd amateurs in each State will endeavor to contact amateurs in other tates.

5. A station may be operated by more han one operator provided that a sepate log is entered for each operator nder his own call-sign.

6. All existing amateur bands may be sed and all transmissions must conform ith the regulations as set down in the MG's Handbook for the Operators of mateur Wireless Stations. Any breaches f these will lead to the disqualification f the operator concerned.

7. The arrangement of schedules for ontacts on other bands will not be permitted.

8. All stations entering the contest will all CQ RD if using CW and CQ. Remembrance Day if using phone.

9. A State competing for the Trophy must submit a minimum of six (6) logs rom financial members before becoming eligible for contesting the Trophy.

10. Only one contact per station per band is permitted.

11. Serial numbers to be exchanged during the contest will be as follows:—

a) For CW the first three figures will be the RST (telegraphy) report followed by the serial number of the contact commencing with any number between 001 and 100 for the first contact and increasing in value by one (1) for each successive contact. If a contestant reaches 999 he will then commence 001, 002, &c.

b) For phone, the first two figures will be the RS (telephony) report followed by the serial number of the contact, in a similar manner to that used for CW.

A complete exchange of serial numbers must take place before any points may be claimed for the contact.

Scoring:—12. In order to provide an equitable distribution of points for States with a large number of contestants compared with a State with fewer contestants, a sliding scale of points has been allotted, as shown in the scoring table appended.

13. In addition to the points in the scoring table that may be scored by a contestant, a bonus of 25 points may be added to the total score for each State worked on the 50 Mc band.

Logs: — 14. The log submitted must show in the following order: Date, operating time, band, emission, incoming signal's call-sign and RST/No., operator's RST/No., time of QSO, points claimed. No log will be accepted unless laid out in the above order.

15. A statement signed by the operator must be attached at the conclusion of the log stating the regulations (Rule 6) and contest rules have been observed.

16. All logs must be forwarded through the contestant's Divisional Council (for membership checking) to reach the Federal Contest Committee, Box 1734, GPO, Sydney, on or before 4th September, 1951.

Awards:—17. Attractive certificates will be awarded to the 1st, 2nd and 3rd highest scorers in each State. There will be no outright winner for Australia. Where a large number of logs are received from any one State, further certificates may be awarded at the discretion of the contest committee.

Trophy:—18. The State to which the Perpetual Trophy will be awarded shall be determined as follows: To the average of the top six (6) logs shall be added a bonus arrived at by multiplying this average by the ratio of valid logs submitted by that State to the total of licensed amateurs in the division at the time of the contest.

19. The logs which will be accepted for the multiplier under Rule 18 shall show at least five (5) contacts in the contest.

20. The Trophy shall be forwarded to the winning side in its container and will be held by that State for a period of twelve months when the winner for the succeeding year is determined.

21. The Federal contest committee shall be the sole adjudicators and their ruling will be binding in the case of any dispute.

Scoring Table:—

VK2 to VK3—1 point, 4-2, 5-3, 6-5, 7-4, 9-6.

VK3 to VK2—1 point, 4-3, 5-2, 6-5, 7-4, 9-6.

VK4 to VK2—1 point, 3-2, 5-3, 6-6, 7-5, 9-4.

VK5 to VK2—2 points—3-1, 4-3, 6-5, 7-4, 9-6.

VK6 to VK2—1 point, 3-2, 4-4, 5-3, 7-5, 9-6.

VK7 to VK2—2 points, 3-1, 4-4, 5-3, 6-5, 9-6.

VK9 to VK2—1 point, 3-2, 4-3, 5-4, 6-5, 7-6.

In the above the first figure in the groups of two denotes the State; the second, points scored. Thus a VK9 contacting a VK3 gets two points, or a VK5 4 points, &c.

OVERSEAS COMMENT

Of considerable interest is the comment offered by HM Postmaster-General (the Rt. Hon. Ness Edwards, MP) at a meeting in Wales. It was the opening of an amateur radio exhibition arranged by the RSGB.

Extracts of the Postmaster-General's speech are as follows:—

"It is all very well to use your shack for the purpose of hiding away from your wife. That may be a legitimate excuse, but I would remind you that if the time you spend there is used for the purpose of gossiping with someone in Brazil about the color of the hair of his wife or about the meat ration, you are wasting valuable ether space which should be available for more serious and scientific study.

"I hope the tendency, which I understand is called 'nattering,' will be eliminated."

Continuing, the PM stated, "Amateurs are free to use their stations as they will, but the manner in which they use them will, I am certain, in the future, be taken into consideration.

"The International Radio Regulations, which were agreed to at the Cairo Conference in 1938, made no provision for the use of amateurs of any frequency between 14 and 28 Mc/s—the frequencies of general value for long distance work. The Atlantic City Conference, held in 1947, did, however, provide a band for amateurs at 21 Mc/s and it was confidently hoped that this new band would be available within a couple of years.

"However, owing to the failure of subsequent planning conferences, the Atlantic City Frequency has not as yet been fully implemented. We must wait and see what the forthcoming conference in Geneva will bring forth.

"If the conference succeeds in devising some method of bringing the new frequency allocation into force there should be a good chance that the 21 Mc/s band will be available to amateurs within a year or so. It is probable that there will have to be an interim period during which amateurs would share the band with services already in operation, until the latter could move to their new frequencies.

"For the present it would be a breach of International Radio Regulations to allow amateurs to use the 21 Mc/s band."

The above extracts give an insight into the department's reaction to the hobby in Great Britain. In reference to the final sentence, it might be noted that two Governments allow 21 Mc/s operation at the moment. They are Southern Rhodesia and the Sudan.

REPRESENTATION

Member societies of the International Amateur Radio Union or, better known as the IARU, are still considering the best means of representation for the hobby, at international conferences. Opinion is divided whether such representation should be at the national or international level.

In other words, should amateur radio societies be satisfied with the support afforded them by their national delegations or should the IARU supply a delegation to attend telecommunication conferences on behalf of amateur radio?

Opinion in America and Europe is sharply divided. In the US the ARRL considers national level representation preferable, while at the 25th anniversary meeting of the IARU, held in Paris last year, it was unanimously decided to support a delegation to attend the next conference (Buenos Aires, 1952—possibly to be postponed). The cost of such a delegation would be considerable and, of necessity, would have to be divided between the societies supporting the idea.

Prewar on two occasions national societies throughout the world financed IARU delegations to CCIR meetings, so the idea is not new.

The IARU is becoming stronger every year and comprises 41 national societies. 14 are located in Americ a, 6 in Asia, 2 in Africa, 16 in Europe and 3 in the Pacific area—PARA (Philippines), NZART and WIA.

A national non-commercial amateur radio society whose influence substantially covers its national territory can be elected to membership in the IARU, one society only being admitted for each country.

The objects of the IARU are as follows:—

The promotion and co-ordination of two-way amateur radio communication.

The affecting of co-operative agreements between the national amateur radio societies on matters of common welfare.

The development of the radio art.

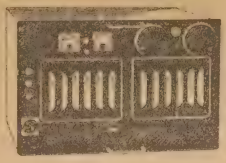
The representation of two-way amateur radio communications' interests at international telecommunications conferences.

The encouragement of international fraternalism.

The formation of such additional activities as may be allied thereto.

Official views of IARU activities appears in the headquarter's society's journal QST, while member societies receive calendars twice annually.

Co-ordination of the world's QSL bureaus and international contests, and



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Parts include:—

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2. Cyclatron valves
2. 4 Ceramic sockets
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2. .015,000 Volt working condenser
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Ideal for Personal Portables or any midget sets. Usual price 22/6.

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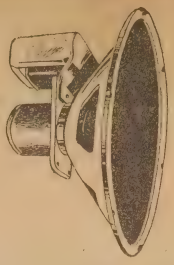

Kingsley 5 inch Permag Speakers with transformer

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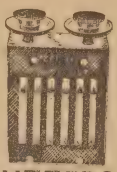

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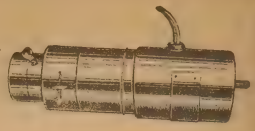

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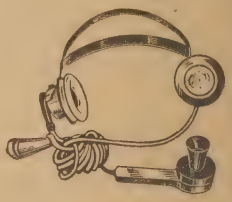

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e issuing of WAC certificates are other ivities.

X PERSONAL.

HE is no longer the prefix for Leichten-n and amateurs will be signing HB9L. is two letters in the future.

The W's are certainly making extensive arrangements to assure their 1951 tional ARRL Convention, to be held Seattle, will be a success. One point rth repeating is the fact that a special in conveying amateurs to the conven-n will run from Chicago to Seattle, a stance of 1600 miles. To make certain e gang will be at home during the trip ecial 115v AC equipment and antennas ll be installed on the train to allow obile operation.

Mentioned last month was the recep-n of a W station on 144 Mc/s by Harry awkins, VK8YL, of Cessnock. Harry s received confirmation that the station, 6FTN, was operating on 144 Mc at the me reported, but was working cross-nd to 28 Mc/s. The W thinks that a ray signal perhaps got into the 144 Mc X—Harry is non-committal on the suo-ct.

Following on this reception, Roy Hart, K2HO ardent UHF man, of Roseville, dney, reports hearing a W1 on 144 c/s at 1200 hrs EAST on June 11, and awaiting confirmation. These two eports are very interesting and on a w occasions signals on this frequency ave been reported reflected from the nosphere.

W8GZ believes he heard a VK on the Mc/s band at 0100 hrs GMT on June The station faded out after a few inutes. W8GZ is on daily and listening it for VK stations from 2200 to 0200 hrs MT. His frequency is 50,200 Kc/s and es a rhombic beamed on Australia.

In the first contact over any distance Sydney, VK2XX, of Sutherland, and K2HO, of Roseville, on the 580 Mc band, ade the grade over 20 miles. Although oth stations are in elevated positions e path is definitely not line of sight.

THE JUBILEE RELAY

Preparatory to the running of the Com-onwealth Jubilee VK/ZL DX contest in ctober, the Federal WIA contest com-ittee under the chairmanship of Wal yan VK2ZTI have arranged "The Jubilee elay" contest for the dual purpose of ublicising the Commonwealth's Jubilee nd the DX contest. Rules for the relay ontest are as follows:

Australian and New Zealand contest-nts will endeavor to send the following essage to as many foreign stations as ossible—

"Australia celebrates its Jubilee this ear and invites you to join in the Jubilee K/ZL DX contest during October."

Australian stations will add the sig-nature WIA and New Zealand stations ZART.

Rule 1—The contest will commence t 001 hrs GMT, September 1, 1951, and onclude at 2359 hrs September 29, 1951.

Rule 2—Phone or CW may be used on ny band.

Rule 3—One point is gained for each ontact with message passed and total oints are obtained by multiplying the otal contacts by the sum total of coun-ries worked on each of the different ands (ie, G stations contacted on three ands would count as three countries for he multiplier).

Rule 4—Logs must be in the hands of he contest committee, Box 1734, GPO, Sydney, not later than October 30, 1951. Logs should show date and time of con-act, band and station worked, a sum-nary should be given showing final score laimed.

Rule 5—A trophy will be awarded the ighest scoring station in both Australia nd New Zealand and certificates to each district or State.

Rule 6—The decision of the WIA Fed-ral Contest Committee shall be final and inding.

Rules for the above contest are quite imple, please do as much as you can to publicise the main contest and send your log in irrespective of the number of contacts.

TUNING CIRCUITS FOR RECEIVERS

(Continued from Page 47).

acitance rating of 100 and 10 nfd. would have its range altered over 35 to 125 mmfd. by connecting a 25 mmfd. auxiliary condenser parallel. And if the auxiliary acitance is made equal to 100 nfd, the resultant capacitance ge would become 110 to 200 nfd.

f the auxiliary (trimmer) conser were variable between these ues of 25 and 100 mmfd., then any nber of maximum and minimum ues (and corresponding widths of idspreads) could be obtained by perly setting it.

By application of relations (1) and various frequency coverages ld be determined.

t must be remembered, of course, t where C appears in those equans and formulas it is taken to be complex term appearing on the ht-hand side in (10).

UXILIARY PADDER

t may be desirable, however, to trict the maximum capacitance of without greatly affecting the minim, in order to achieve a desired quency range, and in such a case auxiliary capacitance (padder) is nected in series with C (see ure 4) and the relations of (11) ply.

In this series combination, if the ning condenser C1 has a range of -100 mmfd. and the padder C2 is uced to 50 mmfd., then the capaance range of C1 is transformed to 50 mmfd. (equation 11).

Note that the tuning condenser aximum has been altered considerably more than its minimum. If the value of C2 is reduced to 50 mmfd., the range becomes 8.3-33.3 mmfd., and if it is reduced further to 25 mmfd., the range becomes 7.1-20 mmfd.

Note also that as C2 is reduced in capacitance it has less reducing effect upon the maximum value of C1, while at the same time not altering the C1 minimum tremendously.

An interesting arrangement is shown in Figure 5 with both trimmer (C3) and padder (C2) made variable to achieve any desired amount of bandspread of band compression. The relations of (10) and (11) are combined to explain the circuit.

In Figure 5 the total working capacitance in parallel with L, neglecting distributed and stray properties, is

$$(12) \qquad C = \frac{1}{\frac{1}{C_2} + \frac{1}{C_1 + C_3}}$$

and equation (1) becomes:

$$(13) \qquad f = \frac{1}{2\pi \sqrt{L \frac{1}{\frac{1}{C_2} + \frac{1}{C + C_3}}}}$$

NEW HYDROPHONE

A TOTALLY different way of picking up sounds in a liquid, with possible application to submarine detection, was recently reported to the Acoustical Society of America.

Ultrasonic waves, much higher than humans can hear, hit a wire covered with a porous coating that is under water. The ultrasonic waves set up in the wire an alternating potential of the same frequency as the sound wave. This effect occurs regardless of the kind of metal used in the wire.

The effect appears to depend on the type of porous covering and the solution with which the wire is covered. The voltage occurs either when the wire is in water or in a solute electrolyte, a solution that will support an electronic current. While the voltage produced is small, it can be stepped up, or amplified, to give the necessary signal.

This discovery is expected to be used extensively in the laboratory where scientists studying sound effects can now use a small wire to pick up sound. Heretofore they have had to depend on much larger hydrophones, ones that might have some effect on the sound being studied.

OFF THE RECORD — NEWS & REVIEWS

This month the microgroove record has reappeared in the news with a bang which has echoed throughout the land. It is the result of a visit to Australia by a representative of the Decca company of England, with a pile of records in one hand and an assortment of reproducing equipment in the other.

BY JOHN MOYLE

THAT sounds like the work of a superman, but Mr. Beecher-Stevens, if he is not a superman, has been going through the actions as far as records are concerned.

Becoming aware that Australia presented an eager market for microgrooves, he was sent out here to make a big noise about them, and to oil up the distributing machinery so that the hordes of ravenous record buyers can get more of the records than has been possible to date.

That Mr. Stevens, if he will pardon the contraction, has been able to hit headlines in almost every newspaper in Australia is a tribute to his energy. Unfortunately, the technical details of the position became tangled in the hands of most reporters so that an inevitable amount of confusion surrounded his energetic activities.

Most of our readers will have a fairly accurate idea of what is involved, but after a few talks with Mr. Stevens, I can sum up briefly as follows:—

Decca records are distributed in Australia by EMI and this company will continue to perform this service. Mr. Stevens' visit was not intended to upset this arrangement, a some readers appear to imagine. E will accept orders for the recor and arrange deliveries according the supply.

To date the supply has not be very great because for one thing, r cord sellers have been rather wa of the records and for good reaso They are anxious to see that buye obtain the full use of them, and fro a retailer's point of view, this complicated because they can't played on ordinary turntables a with standard pickups.

It is essential to have a gram phone motor which will operate 33 1-3 rpm and also to have a pic up with a fine point stylus. This isn so hard, because the motors a here, and pickups are available wi changeable heads, one for 78 a one for 33.

The average homebuilder wo have any trouble in understandi and providing for this. But M Average Man is in a different cat gory. He needs more help than th and the ability to buy a suitab motor pickup combination whi he can use with his present radi gram.

The retailer really needs no sal talk to convince him that micr groove records will sell, and a wanted. But he also realises th there are and will be good 78 r cords sold for a long time, and th his customers will want to buy a play them.

BIG SUPPLIES

Decca, therefore, have said th will solve these problems, or at lea help to, by first sending large qua tities of microgrooves so that r tailers can be assured of supplies. addition, they will market mot pickup playing desks which can used with any equipment suitab for modern magnetic pickups. M Stevens has promised a quarte million records in a few months, a 10,000 playing discs. Whether he c in fact get the shipping space to bri these in may be open to doubt, b he has been sufficiently impress by the potential market here th he can be relied upon to try.

The retail trade must use so enterprise and energy in solving so of the consumer problems for the selves. Some hesitation in the init stages is understandable, but no o can doubt now that the future long-playing records is assured a their introduction inevitable.

It is now up to the record compa ies and those who sell records a equipment to work out the answ for the consumer. There are no dif culties which can't be overcome wi the application of understanding a work. Anyone who sells microgroo

uipment must make himself able answer the question, "How can I ay these records on my radio-am?" and provide the equipment do it.

Most retailers are unused to con-ications of this nature, as selling cords normally is just like selling ything else by the package. A live-re store, realising that a new slant s been given to records and sooner later all record companies must oduce microgroove records of some eed or other — would commence w to build up an extra service of is kind.

Mr. Stevens was misquoted more an once as having said that 78 re-rds soon will be extinct. He didn't y that, and doesn't believe it. He es believe that the speed war will resolved in favor of the 33 record against the 45, although his com-ny now makes plenty of 45's for SA. But he doesn't think the 45 ves enough, and above all, it isn't long player.

He thinks that 78 records for orter and popular numbers, per-aps also some classical stuff, will be re for a long time, maybe per-anently. But he is emphatic that e longplayer has so much to offer l interested in more serious music at nothing can stop it. Decca now regard it as the standard record for serious music.

He admits that microgroove records are hard to make and have caused headaches which are now, fortunately, less frequent. They are also more expensive to make because the rejects for one thing have, to date, been high.

The sum total is that we are promised plenty of longplayers in the next few months, and we can only hope that record dealers will co-operate by helping the public to make the best use of them.

TWO SPEEDS

Leaving Mr. Stevens and his opinions, in the main I agree with him. I am more and more inclined to think that the light stuff will be on 78, and the more serious music gradually changed over to the 33 speed. I am not overlooking the possibility of EMI coming out with an entirely new scheme possibly based on the "super 45" player, to use my coined phrase, but I don't think so.

In practice, it can, I think, be shown that in a few cases—mainly near the end of 10-inch records—45 rpm has the edge, but in practice there is nothing to choose between the two speeds for quality. Elsewhere the 33 speed heads the 45, and in any case, provides that vital extra playing time.

These matters aren't just guesswork—they have been worked out mathematically and can be demonstrated. Bearing in mind the other links in the chain which can make or mar reproduction, I don't think the 45 record can justify its disadvantages.

The Decca-playing equipment—playing desks, amplifiers and speakers—will probably be distributed here through a separate company from EMI, probably a new one. Incidentally, Decca have a novel vented speaker of only 6 inches in diameter in which the enclosure is a narrow box about 3ft 6in high and intended to face into the corner of the room. The sound bounces off the wall to give sound diffusion. I was most interested in this speaker, not only because it follows an idea suggested recently in these columns, but also because it worked so well.

HIGH COST

Unfortunately, the price of these speakers—probably over £50—and also of the motor pickup playing desks — about £35 complete — seems too high. Nor is it necessary to spend money of this type to get good results. Super quality has always been expensive, but a more modest solution than this should be attempted in the interests of Mr. General Public. The home builder can buy a suitable motor and pickup for £10-£12, and can easily arrange to house them, using his present cabinet in most cases.

Apart altogether from Decca's activities, it is to be hoped that the move to better recording will soon become universal. Maybe others haven't much to lose at the moment by allowing a market to be created before entering it. But the time will come—and let us face it—when people will no longer be prepared to pay for a set of 78 records if they can get the same music with better reproduction, low surface noise, and long-playing. When that time comes, there will be nothing for it. Why not now?

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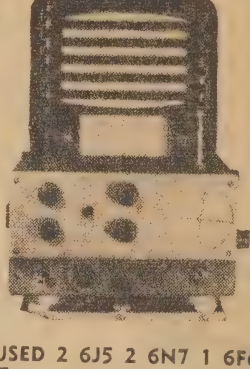

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ANSWERS TO CORRESPONDENTS

E.N.B. (Binalong, NSW) forwards subscription for two years and raises a query on the availability of a recording by Beethoven.

A.: Many thanks for your subscription, E.N.B. It has been handled by the subscription department and you should have the official receipt by now. With regard to the recording "Missa Solemnis" by Beethoven, we feel that you may have some difficulty in procuring this. A check with a few of the larger musical firms in Sydney reveals that it has been cut out of the current catalogue and there is no indication as to its reappearance. We can only suggest that you either attempt to obtain one second-hand or have your name placed on the mailing list of any of the large record distributing firms so that you will be aware at an early stage of the reappearance of this recording if it does happen to come back onto the market. We are pleased to note that you find interest in the Off The Record articles appearing in Radio and Hobbies magazine.

E.A.J. (Mt. Lofty, SA) is interested in obtaining information on connecting multiple speakers" to an 807 amplifier. He suggests that we publish some information on the subject.

A.: This matter has been covered fairly fully in Radio and Hobbies at various times and we could do no better than to refer you to the article describing the installation of a public address system in the May issue. It is just possible, however, that you refer to a multiple speaker network where the various speakers are used to reproduce different ranges of frequencies. In that case, our answer is that at the moment no commercial high frequency speakers are available on the general market and there would be little point in publishing an article which would be of interest to a small minority of readers. You can rest assured that the matter will come up for consideration if and when the special speakers do become available.

C.C. (Cootamundra, NSW) wishes to use a power transformer as an output transformer matching a pair of 6V6-G's to a speaker with a 2.0 ohm voice coil. The transformer has a 285-0-285 volt winding and a primary tapped at 230 and 240 volts.

A.: The transformer could be used as you suggest and with the 230 and 240 volt tappings connected across the speaker voice coil the load reflected back to the 6V6-G's would be about 6500 ohms. This is somewhat lower than recommended and the only way to find out, which is sound with relatively thin wire, is used. If the transformer has a 6.3 volt secondary this could be used without the latter objection. The load reflected back to the 6V6-G's would be about 16,500 ohms. Better still, you could provide a special voice coil winding designed to reflect the correct impedance.

If space is not available otherwise, it would be necessary to remove one or more of the present filament windings. The normal load for 6V6-G's in push-pull class A operation is 10,000 ohms and, in calculating the number of turns for the voice coil winding, remember that the impedance ratio is equal to the square of the turns ratio. Power transformers used as audio transformers work quite well and although the response at the extreme ends of the audio range may not be as good as that of the specially designed job it is excellent for public address and similar applications.

D.K.F. (Geelong, Vic.) is interested in obtaining details of a 3 valve battery receiver.

A.: We have several receivers answering to this general description. D.K.F., and if you care to write to us giving some indication of the valve types you wish to employ etc., and enclosing the 1/- query fee we will do our best to be of assistance.

C.A.C. (Blakehurst, NSW) tells how he physically rearranged the components of the Multi-Talkie vibrator supply so that they would fit into a battery compartment of his own battery receiver. The supply worked satisfactorily as far as providing the required voltages but he is experiencing "hash" interference from the unit.

A.: It would appear, C.A.C., that the presence of the "hash" interference from the vibrator unit is due to multiple earthing within the unit and, possibly between the unit and the set. The method of construction of a vibrator supply as detailed in a number of issues of Radio and Hobbies magazine in articles concerning vibrator set construction has proved quite successful in the elimination of "hash" interference. Basically, this means mounting the vibrator supply components on a metal base plate and taking all earth points to this base plate, preferably close to the one selected spot. This base plate is then completely enclosed in a metal case and insulated from the metal case. The cover of this case must make a good fit with the case all round. The outgoing leads are taken from the internal wiring of the vibrator supply unit out through a hole in the outer case. It may be found necessary during the initial trials to by pass these leads (except the earth lead) to the outer case at the point of exit with the bypass capacitors on the outside of the case. The earth braid is taken from the base plate and connected to the earth point on the outer case to where the bypass capacitors (if used) are eafthed. From this point, the earth lead is taken to the set and preferably connected thereto at some common earth point associated with the filament or B-minus circuits.

YOUR QUERY?

1. Queries will be answered in rotation through the columns of our magazine if not accompanied by a fee for a postal reply.
2. Queries, neatly and concisely set out, will be answered by mail as quickly as possible if accompanied by 1/- in postal notes or postage stamps. Endorse envelope "Query."
3. Back numbers are rarely available but reprints of most circuits, wiring diagrams, and parts lists will be supplied for 6d each, minimum charge 1/-. Thus a circuit, layout, and parts list will cost 1/6 in stamps or a postal note. Endorse envelope "Circuit."
4. Blueprints of exact size chassis layouts with all essential holes, and cutouts will be supplied if available for 2/6. Endorse envelope "Blueprint."

Address your letters to the Technical Editor, "Radio & Hobbies," Box 2728C GPO, Sydney.

R.D.K. (Berry, NSW) sends 12 months' subscription to Radio & Hobbies, and says how much he enjoys the magazine, particularly the "Serviceman" and the popular science articles.

A.: Your subscription has been forwarded to the appropriate department, R.D.K., from which you will receive an official receipt. Many thanks for your kind remarks about the magazine in general, and the particular articles you like best. We hope to keep these going for a long time to come.

J.S. (Mosman, NSW) forwards his subscription and passes comment on the series of "Learn While You Build" articles.

Your subscription has been dealt with by the appropriate department, J.S., and by now you should have received the official receipt. We are pleased to note that the series of articles mentioned above will be of assistance to you and will enable you to follow more closely the more advanced articles.

K.W. (Newport, Vic.) asks why, in connecting a pentode valve as a triode, some circuits show the suppressor grid connected to plate while others show the suppressor connected to the cathode.

A. Local valve companies conducted some experiments some time ago with regard to this point. There are no strong arguments for either connection although some points favor the suppressor-to-cathode arrangement. In consequence some local circuits appeared employing this connection.

American practice has always been to connect both suppressor and screen to plate, and recent local circuits have followed this arrangement. Many thanks for your kind remarks and we trust that you will find many articles of interest in future issues.

C.G. (Balladoran, NSW) sends circuit and details of a matching oscillator which he has used with considerable success, and also suggests several forms of frequency meters to use with it.

A. Many thanks for the suggestion and details C.G. and they have been passed on to our Reader Built It section for possible inclusion at a later date. One of the main problems with equipment of this kind is to ensure sufficient mechanical stability in the actual frequency measuring sections, otherwise the value of the device may be doubtful, and unless full details are given the circuit alone may give the impression that construction is simpler than is the case.

W.H. (Moree, NSW) is interested in searching for uranium and would like some information on the construction of a Geiger counter.

A. We regret we have no information on the construction of these instruments and suggest that it might be better to investigate the possibility of a commercial instrument. We believe that some Australian manufacturers are now making these devices although at the moment we have no details. However, if you contact Philips Electrical Industries, 69-73 Clarence St., Sydney, they may be able to help you.

G.C. (Oatley NSW) asks for a circuit of an amplifier delivering 10 to 12 watts and which can be operated from either the 240V AC mains or from a 6V or 12V acculumator. The input is required to take either a microphone or pick-up or, we presume, both.

A. We feel, G.C., that the 6-240 amplifier (either version) would be just the unit for the job. The first version, described in the February, 1949 issue of Radio & Hobbies, had a channel each for a microphone and pick-up, the change-over from one to the other being by a switch. There was just enough gain for close speaking into a crystal type of microphone to drive the amplifier to full output between 13 and 15 watts. The second version had an additional microphone preamplifier stage which also allowed for the insertion loss of a microphone pick-up mixing system and the introduction of about 6 db of negative feedback. The description of this version appeared in the March, 1949, issue. The drain from a 6 volt accumulator is about 12 amperes. A 12 volt accumulator could be used if the heater circuit were changed into a series-parallel arrangement and the 12 volt type of dual interrupter cartridge substituted. The power dissipation efficiency would probably be a little higher with the 12 volt system.

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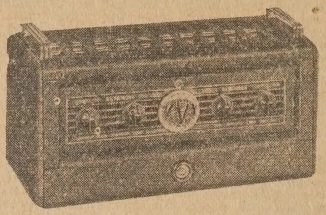

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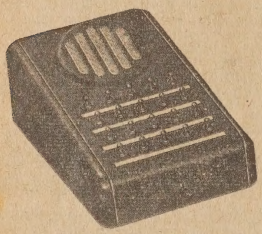

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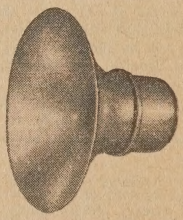

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MAGNETIC RECORDING

(Continued from Page 35)

signers have compromised by using a second motor for this function.

An alternative idea is a "teeter-bar" system, by which either one of two transfer rollers is brought into contact with the master flywheel. In one position the drive is transmitted through a belt or clutch to the take-up spool. In the other position, the drive is removed from this chain and transferred to a high-speed reverse drive for rewind.

A similar effect can be obtained by moving the drive motor bodily to one side or the other.

If the design is carefully arranged, the teeter-bar or motor mount can be manipulated to provide a braking effect, the reverse drive being applied just before the forward drive completely disengages. Normal slipping and frictional losses can even give a temporary slow rewind speed for easy manipulation of the tape, as might be required for spotting a particular section of the recording.

The design problems for a comprehensive twin-track machine are more numerous, because high speed or differential drive has to be applied to either reel, depending on the direction of tape travel. (See figure 3.)

Once again special motors can be employed and switched to give either low or high torque. Alternatively, an automatic teeter-bar device has been used which changes the mechanical linkages when the direction of flywheel rotation is reversed. This, in turn, is accomplished by cutting in an extra idler between the flywheel and drive motor.

Some systems of this type merely reverse the tape travel without providing high-speed wind, but this has severe limitations for everyday use.

Figure 3 illustrates also another method of freeing the tape for rewind. In the play position, the tape is deliberately kinked around guide rollers and the two erase heads, the record playback head being pressure loaded against the tape on the capstan. For rewind, the whole guide assembly is moved back, the tape taking up a new alignment which keeps it away from the capstan and the head surfaces.

On a twin track machine of this nature it is absolutely essential to interlock the controls so that only one erase head can be in operation when the tape is moving, and then only when the controls are set for "record." Unless such provision is made, there is every chance of accidentally erasing track number 1 while recording on track 2, and vice versa.

The record playback head is normally raised or lowered by the mechanism, so that it records on the appropriate track according to tape travel. Some designers prefer to use two permanently aligned heads operating on either side of the capstan.

Figure 3 shows a typical set-up for a twin-track machine using the "flip-flop" system of changeover. The tape travels in the one direction for record or play, and the heads are permanently offset to one side. To use the second track, the reels are simply interchanged, which brings the unused track against the heads.

For rewind, the tape may be run

MAGNETIC RECORDING

(Continued from previous page)

straight across the deck or, more conveniently, disengaged from the heads and capstan by having the heads and pulleys move back by about one-eighth inch.

The problems of driving a machine of this type are no different from an ordinary single-track machine and, in fact, there appears to be no good reason for designing any such machine for single track. A twin-track machine using the flip-flop system involves no performance loss and automatically doubles the playing time per reel of tape.

The vital point is not so much the exact width of the recorded track but the alignment of the tape with the gap and the most intimate possible contact. Any tendency for the tape to buckle away from the gap, or to ride on the wrong position of the head, has a major effect on the frequency response, as will be evident from the accompanying curves.

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FOR SALE: "Royce" 12" recording turntable, motor, senior traversing gear, "Mechanoid" cutting head. Lot, £25. 12 watt recording amplifier, £12. Rola 12-9 speaker, 35/-. "Acos" C.P.12 pickup, and 12" turntable in case, £6. R. & H. springtime portable in leatherette case, £14. University OK1 R.F. oscillator, £5. **R. J. Omant, 8 Heathorn Av., Sandy Bay, Hobart.**

FOR SALE: Radio receiver BC-342-N with speaker and transformer, also 30 valves. Best offer. **46 Knox St., Belmore, Sydney. UL2483.**

FOR SALE: Eddystone 640. Condition as new. £60 or best offer. **K. Echberg, 14 Glyde St., Mosman Park, W.A.**

FOR SALE: New, 3 valve radio in cabinet, two 45 volt batteries included, £12/15/- **P. Gatehouse, Milton.**

FOR SALE: Modified 1155A RCVR. 11 valve. Freq. cov. B.C. 80, 40, 20 Cont. cov. Built in "S" meter, N.L., B.F.O. Excellent HAM RCVR. Complete with spkr., power sup. £30. Less spkr. & power sup., £27/10/-. Or best offer. Also PALEC Model V.C.T. £18. Excellent condition. **D. C. Haberecht, 482 Dean St., Albury, N.S.W.**

FOR SALE: OK1 Oscillator. Good order. £7/15/-. **63 Newington Rd., Marrickville.**

FOR SALE: A.R.8 receiver, AT5 transmitter. AT5 aerial coupling unit, type S power supply for 230v A.C. operation, junction box and connecting cables, instruction manual, A.W.A. class C wavemeter. £70. Write for particulars. **M. M. Ross, 112 Campbell's Cres., Ballarat.**

FOR SALE: Presto Model "K" Recorder. Had negligible use. Excellent condition. Best offer. **"RECORDER," P.O., Box 4, Wickham, 2N.**

SELL: Guitar, Hawaiian. New condition. **Melbourne. UL6586.**

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SELL: BRS recorder, 78 rpm. Newly reconditioned. £31. A bargain. **P. Horne, 71 Malabar Rd., Coogee. FX6472.**

SELL: Tape heads, English Bradmatic record playback, erase. £4/17/6 ea. Oscillator coils, 35kc, 15/- ea. Flywheels, capstans, pinch wheels, shafts, bearings. Write, **Sound & TV, 59 Goulburn St., Sydney. MA1551.**

SELL: Capitol recording gear complete. £9/10/-. **J. Bray, 6 Rawson St., Sans Souci.**

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